# SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS CHEMISTRY, AND MANUFACTURES.

Vol. LXXIX.—No. 13. ESTABLISHED 1845. NEW YORK, SEPTEMBER 24, 1898. $3.00 A YEAR. WEEKLY.

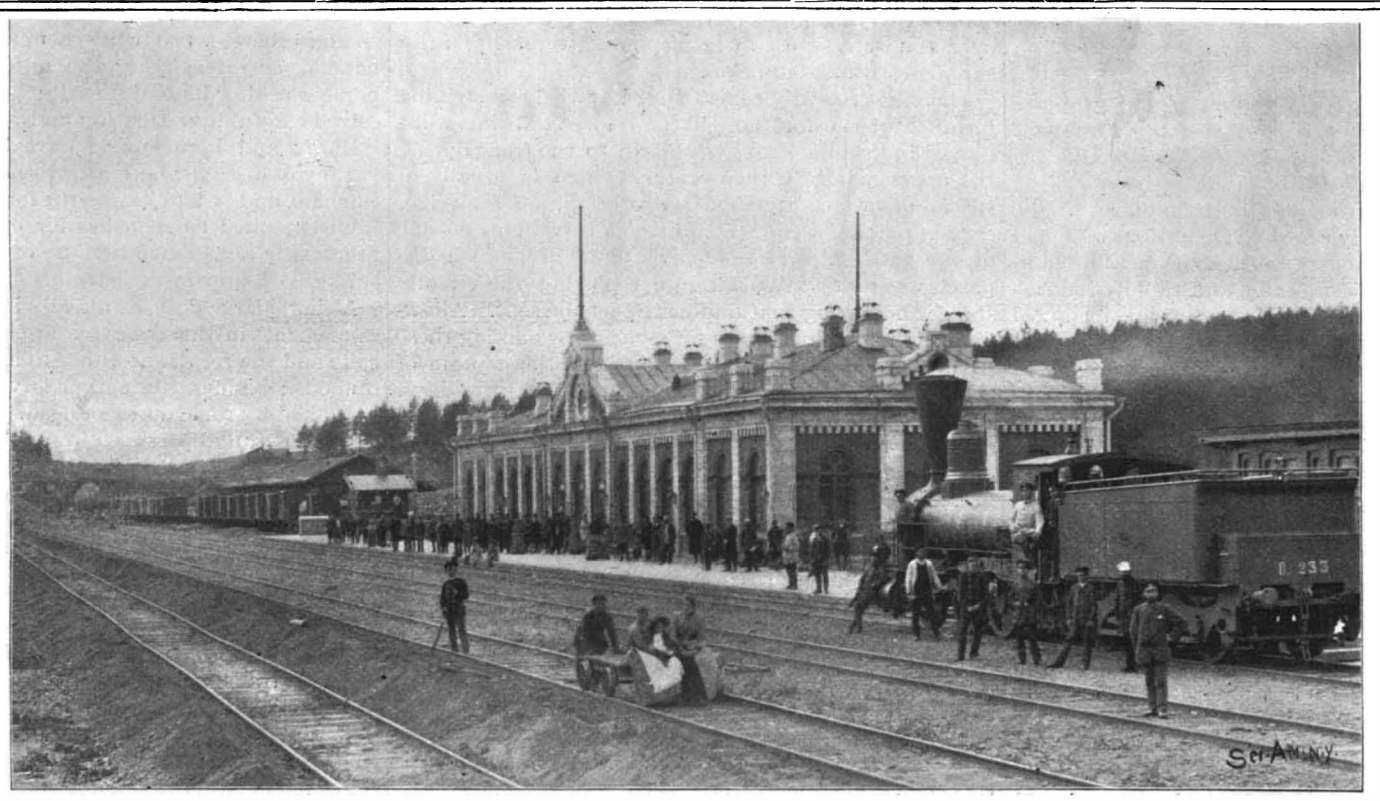

## THE TRANSSIBERIAN RAILROAD.

BY HORACE C. HOVEY.

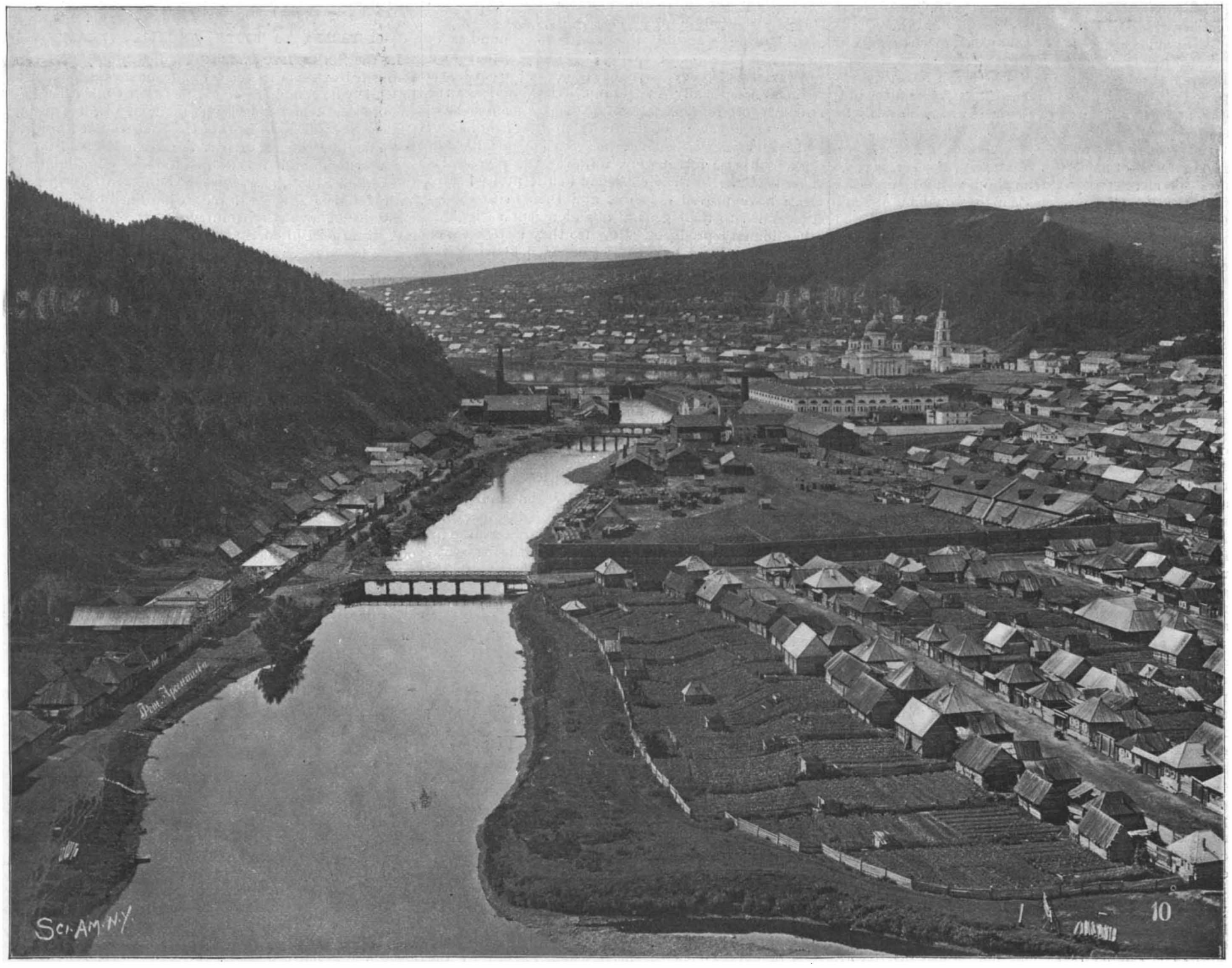
A year ago a card came to the writer from St. Petersburg, which, on being deciphered, proved to be a pass over the entire system of Russian railways.

Maps and special guide books accompanied this favor, and access was also given to official reports. Ours was a geological party, and our errand was to inspect soils, fossils, mines, and quarries; but we could not do otherwise than take an interest in the magnificent iron highways that carried us safely from the western frontier, across limitless steppes, over broad rivers, and beyond the Ural Mountains into Siberia, and then back again to the frontier. As we had a special train, we escaped many of the annoyances usually met with by tourists, and enjoyed every imaginable courtesy and facility for making our trip successful. The paternal oversight taken by our officials was amusing to those of us who were accustomed to American manners, and yet we

(Continued on page 201.)



RAILWAY STATION AT ZLATOOST, RUSSIA.



ZLATOOST, RUSSIA—WESTERN TERMINUS OF THE TRANSSIBERIAN RAILWAY.

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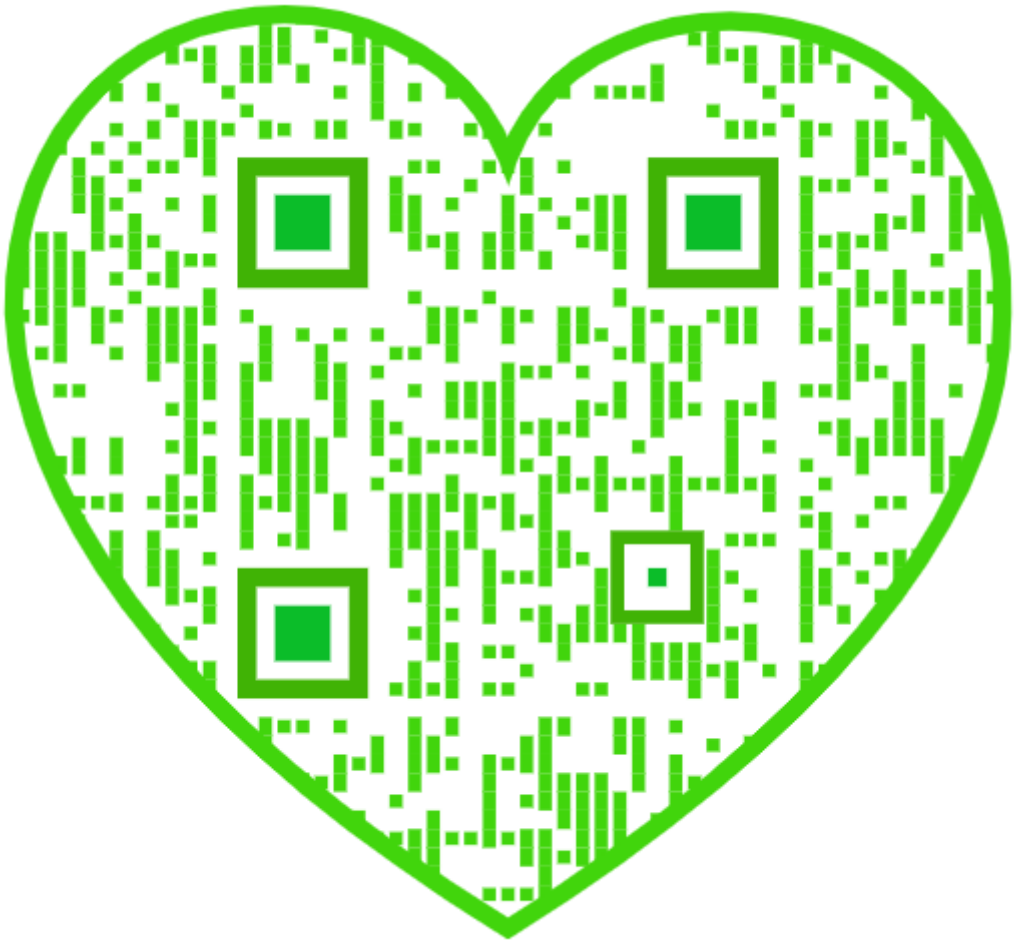

# Scientific American.

ESTABLISHED 1845.

MUNN & CO., - - - EDITORS AND PROPRIETORS.

PUBLISHED WEEKLY AT

No. 361 BROADWAY, - - NEW YORK.

*TERMS TO SUBSCRIBERS.*

One copy, one year, for the United States, Canada, or Mexico ..... $3.00
One copy, one year, to any foreign country, postage prepaid, £0 16s. 5d. 4.00

*THE SCIENTIFIC AMERICAN PUBLICATIONS.*

Scientific American (Established 1845).....$3.00 a year.
Scientific American Supplement (Established 1876) ..... 5.00 "
Scientific American Building Edition (Established 1885). ..... 2.50 "
Scientific American Export Edition (Established 1878) ..... 3.00 "

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Remit by postal or express money order, or by bank draft or check.
MUNN & CO., 361 Broadway, corner Franklin Street, New York.

NEW YORK, SATURDAY, SEPTEMBER 24, 1898.


## OUR NEW POSSESSIONS AS A FIELD FOR ENGINEERS.

We have been asked to state our opinion as to the possibilities of our newly acquired possessions as a field of employment for engineers, both civil and mechanical. There is in our midst a large and rapidly increasing body of young men, graduates from technical schools and colleges, with more or less practical experience in the shop or in the field, who think they see in Cuba, Porto Rico, the Hawaiian Islands, and the Philippines an immediate field of employment of a more remunerative kind, and with opportunities for more rapid promotion, than are possible at home. The expectation is based upon the conviction that our possession or control of these islands will be followed by an immediate and extensive development of their natural resources, in the course of which the services of the civil and mechanical engineer will be in active demand.

The enterprise and ambition which are likely to send many professional men to these new fields are highly commendable; but we fear that those who hasten there at once are doomed to much disappointment. While the next decade is certain to see a wonderful change in much of our newly acquired territory, the development will occur in the latter rather than in the former half of it. We must remember that the Spanish possessions, at least, have been under the control of one of the most conservative races in the world, and that the people of the islands are wedded to old ideas, to customs and habits that crystallized far back in medieval times. Before a period of building up there will have to be a period of pulling down and clearing away, and the process, at least in the earlier stages, will necessarily be slow.

In the reforming and development of the islands the two extremes of modern civilization will meet, for two types of character and temperament more opposite than the Spanish and American it would be difficult to find. The one is conservative, romantic, and wedded to tradition, the other is elastic, practical, and supremely utilitarian; and while it is true that the inhabitants of these islands are not of pure Spanish blood, centuries of Spanish rule and customs have stamped their impress deeply upon the native islanders. For these reasons it is unreasonable to expect that the invasion of these possessions by the railroad, the electric light, the telephone, and the trolley will be as rapid as it was in our Western States, where there was an American population to welcome and assist these prime movers of an up-to-date civilization.

At the same time it must be borne in mind that the operations of the engineer, especially in the civil branches of the profession, presuppose the employment of capital on a vast scale; and capital is always shy of investment in countries where the government is in a disturbed condition. Before any large sums are invested in the construction of railways and highways, in the improvement or provision of water supply, and the general sanitation and reconstruction of cities, the government of the islands must be placed on a satisfactory basis and prove itself to be in a thoroughly stable condition.

When this has been accomplished and the people have adjusted themselves to the new conditions and begun to realize the increased value of property and sanctity of personal rights which have come to them by virtue of the change of government, we may look for an era of material development such as the world has rarely witnessed. The location and construction of a railroad system in Cuba alone will call for the services of a very considerable force of engineers, and the rebuilding of sugar mills, the installing of electric light and power plants, the development of mines and other material resources of the island will present many excellent openings for young men in electrical and mechanical engineering.

For the present, however, we would advise those who are contemplating a trip to one or other of our possessions to stay at home and watch the course of events, meanwhile keeping in touch, as far as possible, with such companies as may be formed for the exploitation of the West Indian and South Pacific possessions.

## FORETHOUGHT IN THE NAVY DEPARTMENT.

In our admiration of the dashing exploits of the navy on the high seas we are liable to lose sight of the excellent work that was done during the war by those officials and assistants whose duties were none the less valuable, arduous, or efficiently performed, because they were carried out at a desk or over a draughting-board. In no branch of the naval service was more faithful work done, or harder work, than in the Bureau of Construction, which had charge of the overhauling of the ships of the regular navy and the conversion of the auxiliary vessels from merchantmen and yachts to cruisers and dispatch and patrol boats, or in the Bureau of Ordnance, which had to see that hundreds of vessels carrying guns of various sizes, and scattered over the waters of two hemispheres, were kept fully supplied with ammunition.

There has recently come to our knowledge a striking instance of the forethought and forehandedness displayed in keeping supplies well up to the front during the operations in Cuban waters, which is worthy of special mention. During the operations off Santiago, certain parts of the mechanism of a turret gun on one of our battleships showed signs of failure, and a dispatch was sent to Washington reporting the circumstance and asking that duplicate parts be sent. Allowing for the time necessary for securing or making these parts and shipping them to Santiago, the captain of the ship expected to receive them in about thirty days. As a matter of fact, they were received in nine days after the requisition was made. This expedition was due to the fact that the ordnance officer at New York had anticipated such occurrences by shipping to Key West and keeping in store a reserve of such parts of our guns as were most liable to failure; and six days after the failure occurred, word reached the battleship that the duplicate parts had left Key West.

In respect of the supply of ammunition (a most vital consideration in these days of rapid-fire guns), it is greatly to the credit of the department that the ships, including those under Admiral Dewey, in the far East, were always fully supplied, while the vessels of Sampson's squadron came back to New York with their magazines completely filled.

## DANGERS ATTENDING SO-CALLED FOOD PRESERVATIVES.

Of late have sprung into existence a number of preparations, claiming to be safe and efficient food preservatives. They have been hawked from house to house, especially in rural districts, and on the strength of representations made by agents have found employment domestically in the canning of fruits and vegetables, and preservation of milk and milk products; fortunately, however, the representations made as to their efficiency in the preparing of meats have proved delusive, and thus in many instances led to their general abandonment as regards other domestic products. How far they have been, or are now, employed by factories engaged in wholesale production and marketing tinned products is a matter solely of conjecture, yet there are good reasons for surmising they are generally ignored, except, perhaps, in the preserving of the poorer and cheaper grades.

The least objectionable of these so-called preservatives owe what little virtue they may be possessed of either to salicylic or boracic acid, sodium salicylate or sodium biborate (borax); it is said that fluoric acid is sometimes employed, but no data or definite evidence is obtainable regarding such use of this agent.

As regards salicylic acid and salicylates, the dangers attending their employment have been thoroughly exploited in the past; further, the changes induced in the presence of fruit acids, whereby abnormal colors are developed, are in the majority of instances inhibitory. Boracic acid and borax, however, are in general use in some foreign countries for the preservation of products that are to be exported, but are forbidden by law as regards those intended for home consumption. These drugs, too, are popularly believed to be "harmless," which if true would simply mean they are inert, and of little or no utility. They are above all cheap and can be obtained anywhere.

Within a few months, several cases of severe and dangerous poisoning, as the result of the employment of boracic acid and borax, have been chronicled in the medical press, both of America and abroad. In one instance five of a family numbering seven souls all told were seized with severe and excruciating colic accompanied by nausea and vomiting, that prostrated the unfortunates for three and four days; the trouble was brought directly home to the milk employed as a beverage, and to which had been added a preservative powder consisting of almost pure boracic acid. Two members of the family escaped because the milk used by them was only what was required for a cup of tea. The same milk, fed to half a dozen fowls, killed all but one, and this was rendered so ill that it was dispatched. In another family, numbering nine individuals, six partook of milk which had been "kept sweet" by the aid of borax, and all were thereby made seriously ill. Several cases of dangerous—and one of fatal—poisoning of infants and children by borax, fed in milk, are on record. Probably many more have escaped notice, the malady being ascribed to "cholera infantum," "summer complaint," colic, etc.

That accidents are not more frequent from the careless and ignorant use of these drugs, aside from the reason just mentioned, is due to causes: First, the distress occasioned thereby closely resembles that which is apt to follow upon indiscretions of diet and improper exposure. Second, many adults are but slightly susceptible to the malign influence of the drugs when they are only taken into the stomach casually and occasionally in moderate and unrepeated doses. As regards milk, it is possible, as has been suggested, that the drugs induce certain chemical changes therein, producing a new toxic agent, or enhancing or intensifying the untoward effects of the boracic acid or its sodium salt; but this has never received careful investigation and study.

Borax and boracic acid have been employed in a variety of diseases, both as internal and topical medicaments, and of late years—the former especially—have been exploited as remedies for epilepsy, though now practically abandoned because of the unfortunate results that follow in their train.

A single large dose, as already intimated, induces derangements in the digestive apparatus that simulate colic and the results accruing to indiscretion in the use of foods; besides, the action is very much like that provoked by toxic doses of lead. When taken in divided doses, and persisted in for some time, a burning, colicky pain in the "pit" of the stomach is experienced, followed by intense nausea and vomiting; the mouth and throat are dry, and there is a remarkable dryness of the hair and skin, the former falling, the latter developing skin diseases resembling eczema, salt rheum, etc. Most unfortunate of all is a tendency on the part of both drugs to develop and foster kidney disease, or when such is already existent in simple and acute form, to transform it into one of chronic, malignant, and fatal character.

With this knowledge, it is evident too much circumspection cannot be employed as regards the use of so-called food preservatives, and that as a rule such should be regarded with the utmost suspicion, particularly if their exact contents or composition is unknown.

## OBSTACLES TO SOUTH AMERICAN TRADE.

In the SCIENTIFIC AMERICAN for June 4, 1898, we published extracts from a letter from a correspondent in Chile who complains of the fact that while it is possible to send small sums by postal money orders from Chilean post offices to most of the countries of Europe, these facilities do not exist as far as the United States is concerned, and if it is desired to remit small sums to the United States, it is necessary either to buy drafts on England or New York. We are informed by the Postmaster-General of this country that the fault does not rest with the United States, for as far back as February 13, 1890, Postmaster-General Wanamaker and Senor Vasas, the Minister from Chile, signed a convention for the exchange of money orders with their respective countries; but, unfortunately, such convention required the approval of the legislative body of Chile, and our government has been wholly unable to ascertain what disposition has been made of it. It is assumed, however, that on account of local changes of government, etc., the matter was dropped. Subsequently, on October 6, 1896, the Director of the Posts of Chile addressed the Department upon this subject, requesting steps be taken to reopen the matter, and on November 28 the draft of a proposed convention was sent to him. No acknowledgment of its receipt was made, however, and on March, 1897, his attention was called to the delay, with a request for a response; but no reply has been received up to the present time, which all goes to show our Post Office authorities are fully alive to the importance of being able to remit small sums to and from foreign countries at a minimum of expense. Our government is also making every effort to provide improved postal facilities between this country and the South American Republics, and it is very certain it is no fault of our very efficient Post Office authorities that such conventions are not now in force. Our correspondent also referred to the lack of a parcels post agreement. There is more difficulty connected with this subject than with Post Office money orders, and when these difficulties have been overcome, there should be no delay in concluding a parcels post convention between the United States and Chile.

IN a work on the algal flora of the Hamburg waterworks, Herr O. Strohmeyer states that the green algæ—Cladophora, Spirogyra, Enteromorpha, Stichococcus, etc.—have a very powerful effect in purifying water by the destruction of bacteria through the agency of the oxygen which they exhale. Those algæ, on the other hand, which are inclosed in a mucilaginous sheath, especially diatoms, have a very prejudicial effect on drinking water, by stopping the filters through which it passes.

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## THE LAKE ERIE AND OHIO RIVER SHIP CANAL.

BY WILLIAM GILBERT IRWIN.

The present is an age of waterway development, and while the move to cheapen and facilitate internal communications is general, it is as marked in no other section as in the Ohio Valley. But few sections of our country are so eminently adapted to the construction of artificial waterways, hence this unusual activity in this particular region. The question of internal water communication is no new one to the people of the Ohio Valley, for as early as 1770 no less a personage than George Washington visited this section and examined the country with a view to the establishment of communications between some of the streams. During the years intervening between 1820 and 1850 the country between the Ohio and Lake Erie was permeated by a network of canals, and in those days of the towpath Pittsburg and other towns in this section saw busy days.

But the advances of latter day civilization have wrought many changes. The great question now occupying the attention of the people of the Ohio Valley and those of other sections of our country is the construction of canals whereon great freighters and large passenger boats may speed on their great mission of disseminating the manifold products of commercial activity. Nowhere else have capital and labor already wrought such mighty wonders as here in the Ohio Valley. From a commercial standpoint Pittsburg really controls the Ohio Valley. Within her borders and at her doors this great manufacturing city has storehouses of treasures such as are rarely met with on the face of Mother Earth. The real source of the greatness of Pittsburg lies in her vast fuel supply, and as a result she has grown to prominence in varied fields of industry.

Through the excellence of her natural waterways Pittsburg has thus been able to maintain with comparative ease her relative foremost position in the varied manufacturing fields in which she is engaged. While Pittsburg is, indeed, a city of many industries, it is in the iron and steel manufacturing industry that she has attained pre-eminence. From the great iron ranges of Minnesota and Michigan come the raw ores which enable Pittsburg to retain her censorship on this vast industry. The cost of transporting hither these ores has long been a perplexing one to the Pittsburg manufacturers. The expense of a long water voyage from Duluth to Ashtabula, together with the docking and added to this the cost of transporting the ores from the docks by rail to Pittsburg, is at the present day one of the most troublesome obstacles with which the Pittsburg manufacturers have to contend.

From carefully compiled statistics, it is found that the approximate through traffic of the railroad lines traversing the country between Pittsburg and Cleveland, through which the new canal is to pass, consists annually of 7,000,000 tons of iron ore, 7,000,000 tons of coal, 2,000,000 tons of coke, 1,000,000 tons of heavy manufactured products, and 1,500,000 tons of lumber and general merchandise. This gives a grand total of 18,500,000 tons, and from this we can safely base an estimate on 13,000,000 tons as the probable annual tonnage over the cheaper water route immediately after its completion. The present cost of ore from Lake Superior to Pittsburg is $1.95 per ton, of which 80 cents is for the lake shipment of 761 miles and $1.15 for the railroad shipment of 128 miles. The rate per ton on the old canal which connected Lake Erie with Pittsburg over the same route which the ship canal will traverse was 13 cents, and added to this were lockage charges of 38 cents per ton. Were the old rates to be revived on the new canal a saving of 77 cents per ton on iron ore would be made. In the same manner the tariff on coal may be reduced from the present rate of $1.05 to 33 cents, a saving of 72 cents per ton. Thus Pittsburg coal can be delivered at Chicago for $1.67 per ton, at Duluth for $1.50, at New York for $1.75, and at Montreal for $1.60, at corresponding reductions for all points reached by the lake connections.

Let us apply these economies to the traffic of the section in question as it exists to-day. Omitting, too, the inevitable increase of traffic resulting from the radical reduction of rates, we still have an annual saving of $4,496,082 on iron ores shipped into the Pittsburg district and also a saving of $4,868,561 on the return cargoes of coal, and of $1,414,044 on those of coke, or a total reduction in the cost of iron ore, coal, and coke of $10,778,687. The resultant economy from the construction of the canal in the six great lake ports would be $11,852,876 for coal. The canal district would save $4,496,082 for iron ore and the lake district $1,414,044 for coke. Thus the annual economy resulting from the construction of this commercial highway would be more than one-half the estimated cost of the work were we to take into consideration but these three leading commercial products.

The above figures are specific ones. To a great extent the whole shipping interests of the Great Lakes, and those of the Ohio and tributary streams, would be benefited by the opening of this internal waterway. From the latest obtainable official figures, the Great Lakes are credited with an annual tonnage of 53,424,482 tons, the Ohio River with 15,600,439 tons, and the Monongahela with 4,275,504 tons. To this we can add 953,406 tons credited to the Allegheny River. This gives the canal direct connections with waterways which carry 74,253,881 tons of commercial products annually. The vastness of these figures might well arouse one's skepticism. While it is not to be inferred that the traffic of the canal will approach anything near these figures they go to show the marvelous extent of the water communications which the canal will establish. The length of these commercial highways is many thousand miles.

To the traffic of these waterways add the railway traffic of the sections in question. The traffic of those roads centering in Pittsburg is not excelled elsewhere in the country. In spite of the fact that Pittsburg is eminently adapted to water traffic, and that the city has fine water communications, yet its railway traffic has grown to proportions most marvelous. In 1895, the roads of the Pittsburg district hauled 1,989,236 cars of freight with a tonnage of 39,784,730 tons. Add to this the tonnage of the roads centering in the lake region at the northern terminus of the canal, and you will have some idea of the railway traffic now engaged in here in this region. Add to this the water traffc as given above and you will have some idea of the universal import the construction of this canal bears to this country and to the world.

The vast commercial traffic of the region to be benefited by this internal improvement speaks most eloquently of the industrial development attained here in the Ohio Valley and in the lake sections to be affected by the canal. Another point which must not be lost sight of is the extent of population of the region in question. Taking the great cities to be connected by this ship canal and giving each a radius of sixty miles, which is approximately the district which centers in such a city, we have a population as follows: Pittsburg, 1,608,964; Chicago, 1,565,360; Cincinnati, 1,168,308; St. Louis, 967,578; Buffalo, 917,028; Cleveland, 800,181; Detroit, 662,192; St. Paul, 644,309; Milwaukee, 581,713. These nine commercial centers, which will be connected through the Lake Erie and Ohio River Ship Canal, have a combined population of 8,915,633. But all these figures cannot fully convey to the mind the import of this new canal.

It is but fitting that the typical city of Pittsburg should take the initiative step toward the construction of this internal waterway. After having been agitated for some years, the work was finally taken up by the Pittsburg Chamber of Commerce in 1894, and through funds raised by subscription a preliminary survey has already been made. The canal has also been chartered and its construction is now assured. But private instead of public capital will accomplish this boon to internal commerce.

The route to be traversed by the canal lies through western Pennsylvania and eastern Ohio. According to the most practicable proposed route, the length of the canal will be 122·16 miles from Pittsburg to Ashtabula. This route is as follows: From the Davis Island Dam in Pittsburg Harbor to the slackwater of the Beaver River, 23·26 miles; thence up the Beaver and Mahoning Rivers by a slackwater system of pools and dams 46·26 miles to Niles; thence by canal 8·74 miles to plateau 900 feet above the tide and 200·08 feet above the Pittsburg Harbor; thence 31·25 miles across the summit; thence descending in a distance of 12·55 miles to the level of the lake, 572·86 feet above tide.

The 23·26 miles of the canal which traverses the Ohio River has been improved by the United States government, which leaves but 98·9 miles to be constructed. It must be remembered that it is proposed to carry on this canal lake freighters of 2,000 tons or of even a greater capacity. This will necessitate a 15 or 20 foot channel. The thirty-three locks of the canal will have a length of 270 feet and a width of 45, and a 15 or 20 foot channel.

The estimated cost of this internal improvement is, in round numbers, $33,000,000. Its estimated revenue from tolls on coal, coke, and iron is $3,169,049 per annum, and deducting from this the cost of maintenance and operation, there still remains a net annual revenue of nearly $3,000,000. The canal will furnish cheaper ores and cheaper foods to the great manufacturing centers. To the Great Lakes it will furnish cheaper fuel, and as a cheaper avenue of commercial communications between the Great Lakes and the Ohio and Mississippi Rivers the canal will prove to be of the highest economic value.

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THE rapid rise of the land about Hudson Bay is said to be the most remarkable gradual upheaval of an extensive region ever known. Driftwood-covered beaches are now 20 to 60 or 70 feet above the water, new islands have appeared, and many channels and all the old harbors have become too shallow for ships. At the present rate, the shallow bay will disappear in a few centuries, adding a vast area of dry land or salt marsh to British territory in America.

## DR. JOHN HOPKINSON.

The scientific world has been greatly shocked by the tragic death of Dr. John Hopkinson. A few days ago, accompanied by his son and daughter, he essayed the ascent of the Dent de Veisivi. The party started early from Arolla, and as Dr. Hopkinson was an expert mountaineer and as the ascent is not considered difficult, no guide was taken. When the party failed to return, search parties were organized and at daybreak the bodies of the distinguished electrician and his children were discovered still roped together on a moraine at the foot of the cliffs. At points on the ascent the footing is difficult, and it is surmised that one of the party must have slipped and all four fallen from rock to rock a distance of several hundred feet. Electrical engineering suffers a severe loss in the death of this brilliant English electrician. He combined, in a rare degree, the qualities of the mathematician with the skill and resources of the engineer. There is scarcely a branch of electrical work that does not owe something to him, and his work was theoretical as well as practical. His greatest invention was an improvement on the Edison dynamo, which is known as the Edison-Hopkinson machine. In 1882 he filed his famous three-wire patent, which he afterward sold to the Westinghouse Company for nearly $100,000.

## MOUNT YILLIMANI ASCENDED.

Sir William Martin Conway, the explorer, cables from La Paz, Bolivia, that he has successfully ascended Mount Yllimani, or Illimani, one of the loftiest mountains of the Bolivian Andes, about twenty-five miles east of La Paz. Sir William says that the ascent of 22,500 feet occupied five days. On the fourth day the Indian porters employed to carry the expedition's baggage ran away. The party suffered great weakness during the last hour they were on the summit, but none of them were injured. Their experience was like that of Mr. Fitzgerald, who ascended Aconcagua.

Sir William was accompanied by the guides who ascended Mount St. Elias, in Alaska, with the Duke of Abruzzi, in 1897.

Mount Yllimani is a serrated ridge with four principal peaks. The snow part of the East Cordillera begins with the gigantic mass of Mount Yllimani, and proceeds in a continuous line of snow-clad peaks to the group of Vilcanota, where it unites with the Cordillera of the coast. On its north side it has glaciers above the height of 16,350 feet. On it also is the Lake of Yllimani, 15,950 feet above the sea.

Sir William Conway is the son of a clergyman, and has traveled much in Europe, Asia, the Arctic regions, and South America. In 1892 he explored the Himalaya Mountains, reaching an altitude of 23,000 feet. In 1894 he traversed the entire range of the Alps, and in 1896 and 1897 he explored the interior of the island of Spitzbergen, and discovered that its central portion is a vast icy plateau. He is the author of several books on mountaineering, and is regarded as an authority on the subject.

## SOAP AS A DISINFECTANT.

The use of soaps containing a disinfectant of some kind has become so general that observations on the practical value of such combinations cannot fail to be of interest. Dr. Reithoffer has recently published the results of some experiments carried out by him with various kinds of soap, having for object to determine their value as microbicides. He used the ordinary mottled soap, white almond soap perfumed with nitrobenzine, and hard potash soap. He found that these soaps were very inimical to the cholera microbe, a 1 per cent solution killing them in a short space of time, while a 5 per cent solution of the potash soap killed them in five minutes. We are, therefore, at liberty to infer that, as in washing the hands the strength of the soap solution is never less than 5 and may go as high as 45 per cent, this method of disinfecting the hands, as well as the clothes, etc., is fairly trustworthy. Much stronger solutions are required, however, to destroy the bacilli of typhoid, the colibacillus, etc., not less than 10 per cent being sufficient. None of the soaps experimented with appeared to have any effect on the pyogenic microbe. The practical result of these investigations is that it is always preferable to use soap and water first of all, rinsing the hands in the disinfectant solution afterward. This is an important point which merits to be generally made known.—Medical Press.

## Congress on Public Art in Belgium.

The first International Congress on Public Art will meet at Brussels, September 24–28, 1898. The Belgian Minister says that he is instructed by the Minister of Foreign Affairs in Belgium to invite the government of the United States to send delegates to this congress. Many eminent persons have consented to act as presidents and honorary members. According to the circular, the programme will have three divisions: public art from the standpoint of law and regulations, from the social standpoint, and from the technical standpoint.

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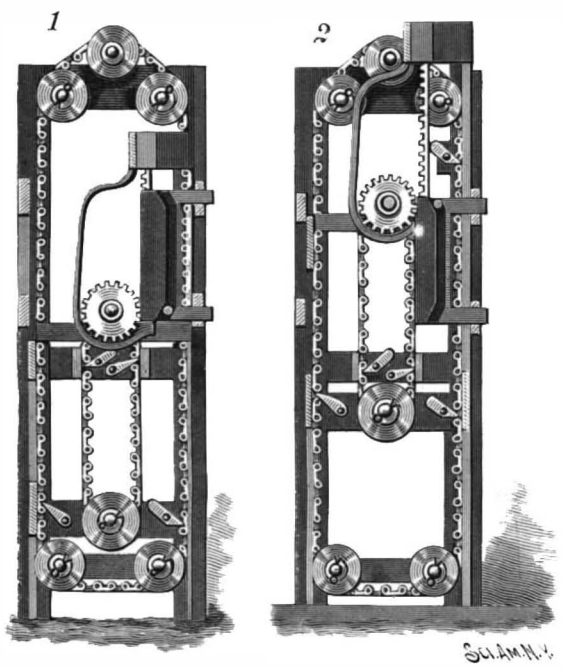
### A NEW TIDE MOTOR.

The main difficulty with tide motors is that at the ebb and the flow of the tide there are two points at which the motor is forced to stop. This defect in tide motors is obviated in the invention of Mr. Silas P. Tomkins, of Tilly Foster, N. Y., which is adapted to give a continuous motion to the shaft irrespective of the period when the motor is inactive. The power for the purpose of imparting motion to the shaft during the period of rest is practically stored up by the motor during the period of action of the tide. A casing of




TOMKINS' TIDE MOTOR.

any approved construction is erected over the tidal flow, and is adapted to receive a slidable cage which travels in the casing and is actuated by a float which rises and falls with the tide. At the top of the casing are three chain wheels, the center one being secured to a shaft from which the power is taken off. There are two chain wheels at the bottom. This arrangement is duplicated on both sides, so that there are ten chain wheels in all. Over these chain wheels pass chains which are engaged by pawls secured to the cage. The pawls are given an inclination in opposite directions, so that uniform motion in one direction is given to the shaft whether the cage ascends or descends. There are bars fixed across the casing which secure pawls which engage shorter chains which pass around two wheels secured to the upper and lower parts of the cage. To the shaft of the upper cage wheel is secured a pinion which engages a rack which is adapted to move a weight which is secured to it. The rack runs in a groove in a frame which is secured to the casing in such a manner that it slides laterally, so as to bring the rack into communication with the pinion, which is accomplished by a pin which is an integral part of the movable cage. It will be seen by the nature of the channel in which the pin runs that, at the top and bottom of the stroke, the pin forces the rack out of engagement with the pinion. At the up stroke the pawls engage the chain, causing the pinion to revolve and, consequently, the rack to move upward, carrying the weight with it until it reaches the highest position shown in our Fig. 2. There is then an interval of time before the tide ebbs. The rack has been forced out of engagement and the pawl on the weight catches the chain and by force of gravity turns the shaft through the medium of the chain and chain wheels. When the cage begins to descend, the pinion again meshes with the rack, the pinion being turned by the chains which are caught by the pawls on the fixed bar. This motion of the pinion causes the weight to remain stationary while the cage is descending, the condition being shown in our Fig. 1. When the cage reaches its lowest point, the rack is disengaged, the weight drops down the same distance as before, keeping up a continuous motion, and when the cage begins to ascend, the pin and rack engage and the weight is raised to its highest position and the operation is repeated.

### THE LARGEST FLOATING DOCK IN THE WORLD.

The great floating dock recently constructed for the Vulcan Company, Stettin, Germany, by Messrs. Swan & Hunter, of Wallsend, Newcastle-on-Tyne, surpasses in capacity the floating dock built by the same firm for the Spanish government and now in operation at Havana. We illustrated the Havana dock in our issue of October 6, 1897, and the remarkable achievement of towing it successfully across the Atlantic Ocean is fresh in the public mind.

The present dock, like its predecessor, was built from the designs of Messrs. Clark & Standfield, of Westminster, the well known dock engineers. It has been constructed with special reference to the lengthening and re engining of two of the Atlantic liners of the North German Lloyd Company.

The principal dimensions are: Length over all, 510 feet; extreme breadth, 110 feet 9 inches; height from bottom of pontoon to top of walls, 43 feet 7 inches. The internal width is sufficient to allow vessels up to 82 feet beam to be docked, and the depth over the keel blocks is 24 feet. The maximum lifting power is about 12,000 tons.

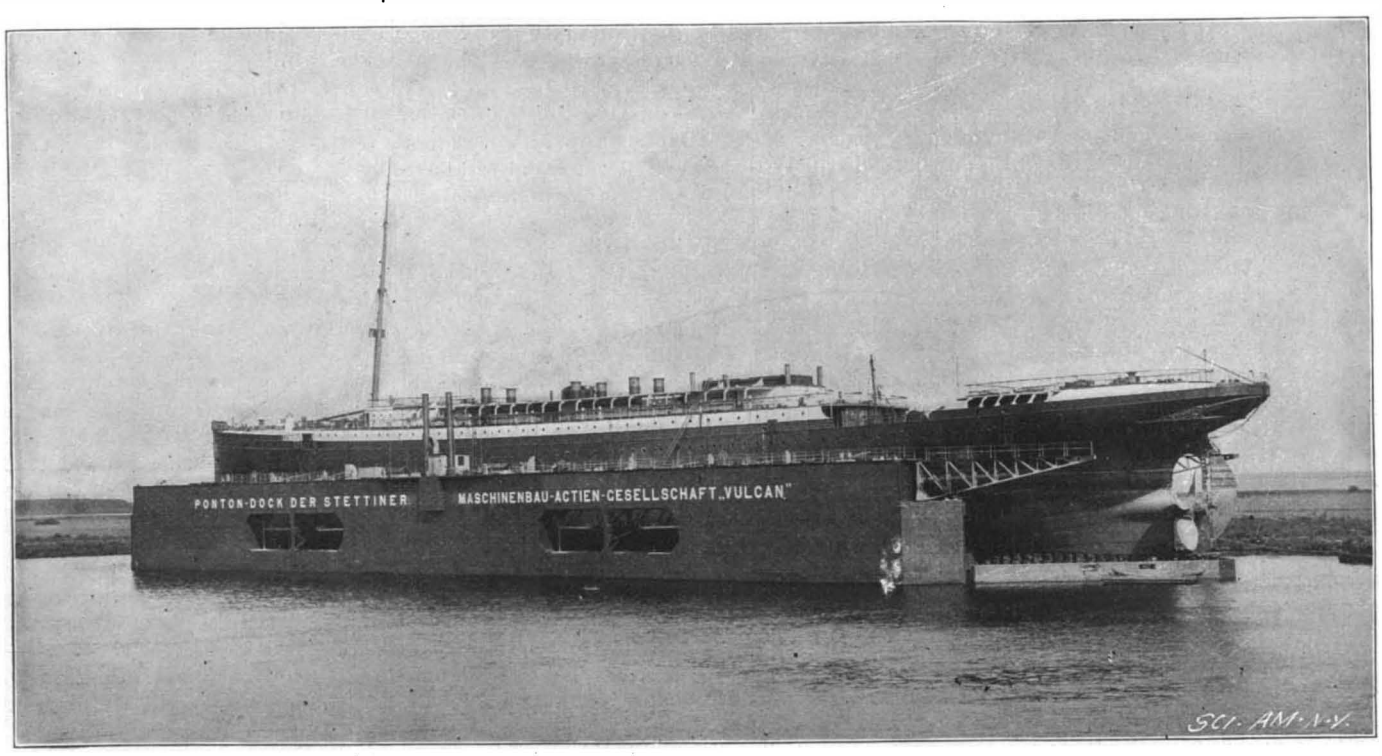
The dock is what is known as the self-docking type, that is to say, access to all the external surfaces is possible for painting or repairs. Longitudinally it consists of two side walls, between which are connected three pontoons, the center one being 240 feet long, and the two end pontoons 135 feet. The pumping and controlling machinery consists of eight horizontal centrifugal circulating pumps, placed four in each wall of the dock. These pumps have large vertical shafts, geared by means of bevel wheels and horizontal shafts to two sets of compound engines of 125 horse power each, which are placed on a deck near the top of the walls. There are four engines in all, and each of them drives two 15-inch centrifugal pumps, the whole machinery being capable of lifting a ship of about 11,000 tons displacement clear of the water in about two and a half hours. The dock is divided into 38 watertight compartments, each emptied or filled by separate valves. Each engine is supplied by a large, horizontal multitubular marine boiler which is placed in the walls in close proximity to it.

The main line of suction pipes is laid at the bottom of the pontoon walls, and runs the entire length of the same. Branches are carried through the walls into the pontoon itself, connection being made by means of flexible joints. The valves for regulating the emptying and filling of the dock, of which there is of course a great number, due to the subdivision of the pontoon, are all manipulated by means of rods and levers from central houses placed one on each wall. From this position also the engines for driving the pumps can be started or stopped at the will of the engineer in charge. The whole of the controlling gear is so arranged that two men, one on each wall, can control the pumping gear of the entire structure.

We have referred to the Stettin dock as being a self-docking structure. It is so named because of the facility with which all parts of the structure can be got at, if desired, for painting, etc. Each pontoon can in turn be detached, lifted, and hung up on the side walls, and while it is in this position any part of it may be examined and repairs, etc., carried out. The underneath portion of the walls, moreover, may be exposed by careening the structure; in fact, any work may be done upon the dock that in any other floating structure would necessitate a visit to a drydock.

In docking a ship, the dock is sunk until the upper floor of the pontoons is well below the level of the ship's bottom. The ship is then floated in between the walls and secured in the desired position. The pumps are then started, and as the buoyancy of the pontoons increases, they lift the vessel steadily out of the water.

The advantages of this form of dock are that its first cost is far less than that of a first-class graving dock; it may be moved to any desired position when the depth of water is sufficient for its operation; it may be built and towed many thousand miles, as in the case of the Havana dock, to its destination, and as compared with the timber docks, it is more reliable and durable.

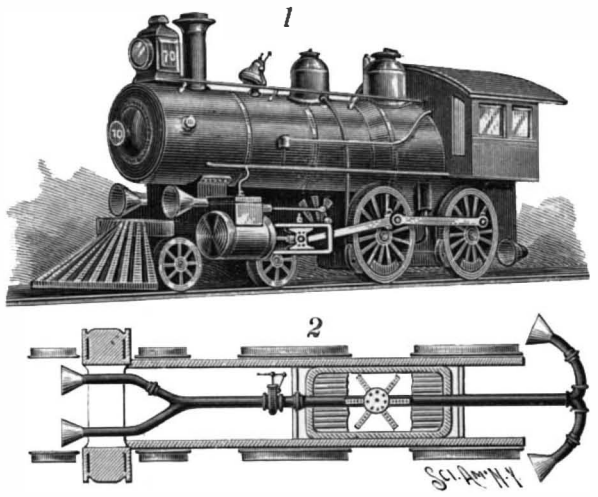



STETTIN FLOATING DRYDOCK, CARRYING THE NORTH GERMAN LLOYD STEAMSHIP "SPREE."

Dimensions of Dock: Length, 510 feet; extreme breadth, 110 feet 9 inches; height, 43 feet 7 inches. Lifting power, 12,000 tons.

### DRAUGHT ATTACHMENT FOR LOCOMOTIVES.

Our engraving represents a new draught device for locomotive engines invented by Mr. Michael Kelly, of Bloomington, Ill. In this arrangement funnels are mounted on the forward end of the locomotive and also at the rear of the driving wheels, extending outside the same so that the air will have free access to them. The funnels open forward and are each connected with an air pipe which conducts the air into the ash pan, where they are connected with a T. From this T a vertical pipe extends upward and is surmounted by a




DRAUGHT ATTACHMENT FOR LOCOMOTIVES.

series of pipes extending radially which are perforated upon their upper surface so as to discharge the air beneath the grate. The forward section of the air supply pipe may be closed by a valve or damper which may be closed when desired. When this device is in use, the dampers of the ash pan are preferably closed and the flow of air through them prevented, but, if desired, the dampers may be opened, so as to admit an additional quantity of air. When the locomotive is running, the air is forced through the funnels and directed into the firebox in a strong stream, causing a rapid combustion of fuel upon the grate. The device has been tested on the Chicago and Alton Railroad by Mr. H. Monkhouse, superintendent of machinery. Engine No. 86, in running 5,860 passenger miles, used 233 tons of coal, or $25\frac{15}{100}$ miles per ton, while engine No. 170, fitted with Mr. Kelly's device, ran 1,810 passenger miles with 38 tons of coal or $47\frac{68}{100}$ miles per ton. The same engine, in running 1,263 freight miles, used 68 tons of coal or $21\frac{61}{100}$ miles per ton. The total average was $28\frac{99}{100}$ miles per ton for the 3,073 miles run. The engines were both in good order. There was also less back pressure with the new draught mechanism and it admitted of working more steam on a hard pull.

IT is stated that Alberto Ricci, of Turin, has discovered that solution of hydrogen dioxide rapidly disintegrates hardened masses of cerumen in the ear. A small quantity of the liquid is poured in, allowed to remain a few moments, and the passage is then syringed with water.

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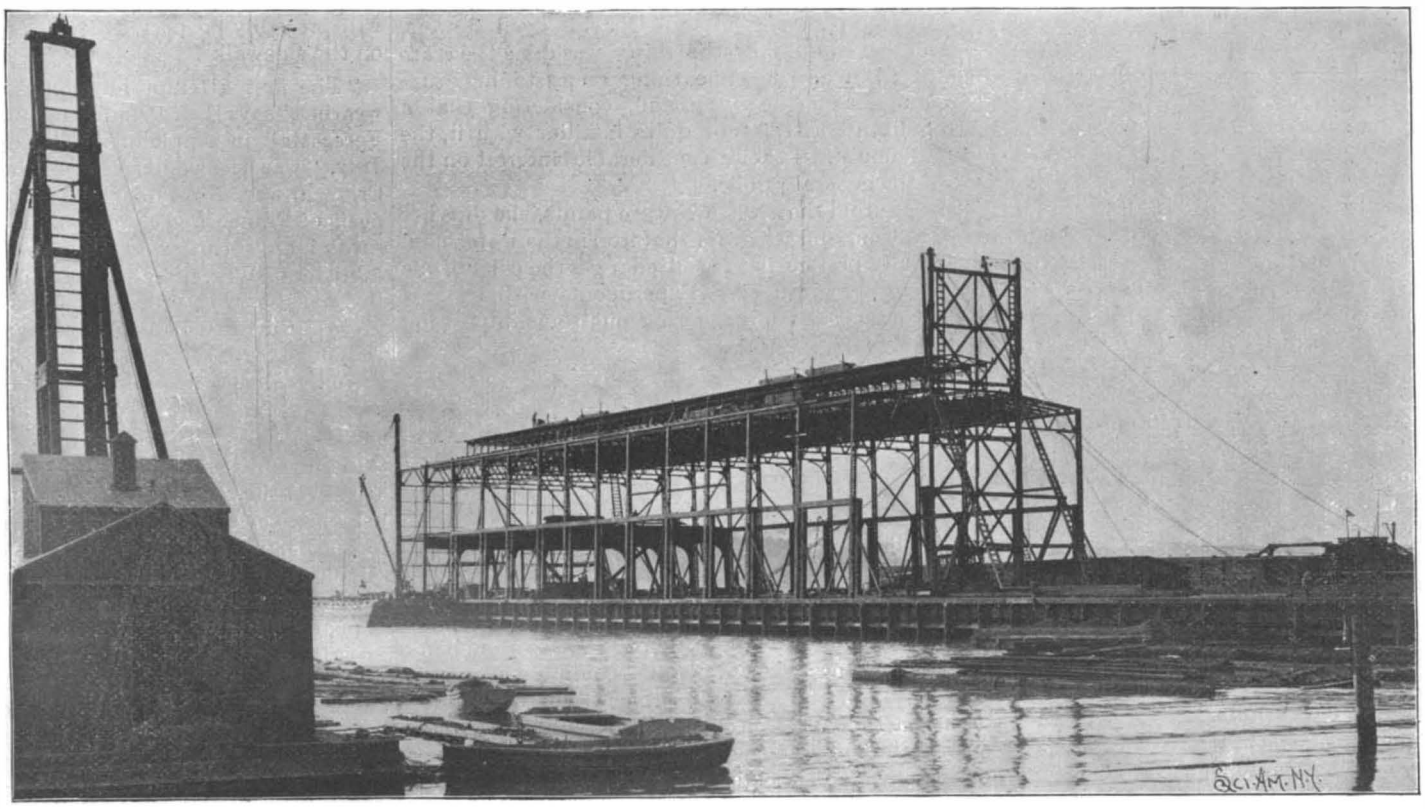
## COLLAPSE OF THE WILSON LINE PIER SHED AT NEW YORK.

Brief reference was made in our last issue to the remarkable wreck of a large pier shed which is in course of erection for the Wilson Line of steamships in this city. The shed is one of a set of five that are being constructed on the New York side of the Hudson River, a little to the north of the present Christopher Street ferry. Two of these are for the White Star Line, two are for the Cunard Line, and the fifth for the Wilson Line of steamships. One of the sheds for the White Star Line has been completed, and at the time of the accident the framework for the Wilson shed and for one of the Cunard sheds was partially erected but not inclosed. Both structures were advanced to about the stage shown in the accompanying illustration of the Cunard pier and building.

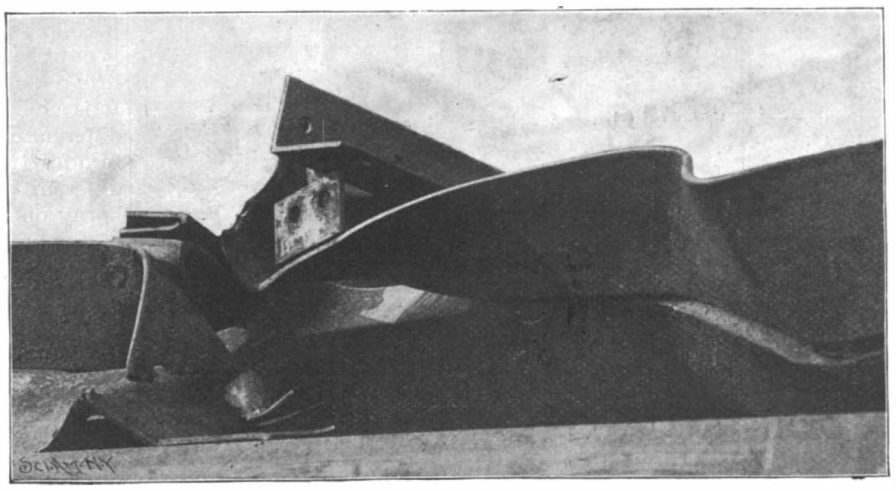


CUNARD PIER SHED IN COURSE OF ERECTION.
(This building, adjoining the Wilson Line Shed, survived the storm.)

The storm which wrecked the Wilson Line building was in one respect the most severe on record, the velocity of the wind reaching a maximum of 72 miles an hour, which lasted for fully 5 minutes. This has been exceeded in the history of the city, but the maximum intensity of the storms has never lasted for so long a period. A remarkable feature about the storm was the total absence of any premonitory warning further than a gathering of heavy clouds in the southwest. The full strength of the blast struck the building diagonally, the direction of the pier being approximately east and west, and the whole of the ironwork, including fourteen bents, with their heavy transverse floor girders and roof trusses, fell over to the east, each bent pivoting on its foundation plate and falling upon the neighboring bent to the east.

The cause of the disaster is to be found in the extraordinary force of the wind, coupled with the small amount of longitudinal wind-bracing throughout the structure. This insufficiency (we had almost said entire absence) of longitudinal wind-bracing is not peculiar to this pier shed, which is a structure of the first class, is of the standard type of construction used in the large pier sheds of this port, and is being built by the firm which has put up all the notable buildings of the kind erected in New York during the past few years. We venture to say that the same absence of longitudinal bracing will be found to characterize in greater or less degree many of the pier sheds, warehouses, and train sheds throughout the country.

By the courtesy of Chief Engineer J. A. Bensel, of the Dock Board, and W. S. White, the resident engineer in charge of the work, we were enabled to inspect the work and take the accompanying photographs of the wreck. The plans of the building were prepared by the engineers of the Wilson Line and were passed by the Dock Board, the matter of detailed inspection during erection being arranged between the Wilson Line and the contractors. The building was erected upon a pile pier, and, when completed, will cover an area 120 feet wide by about 730 feet long.



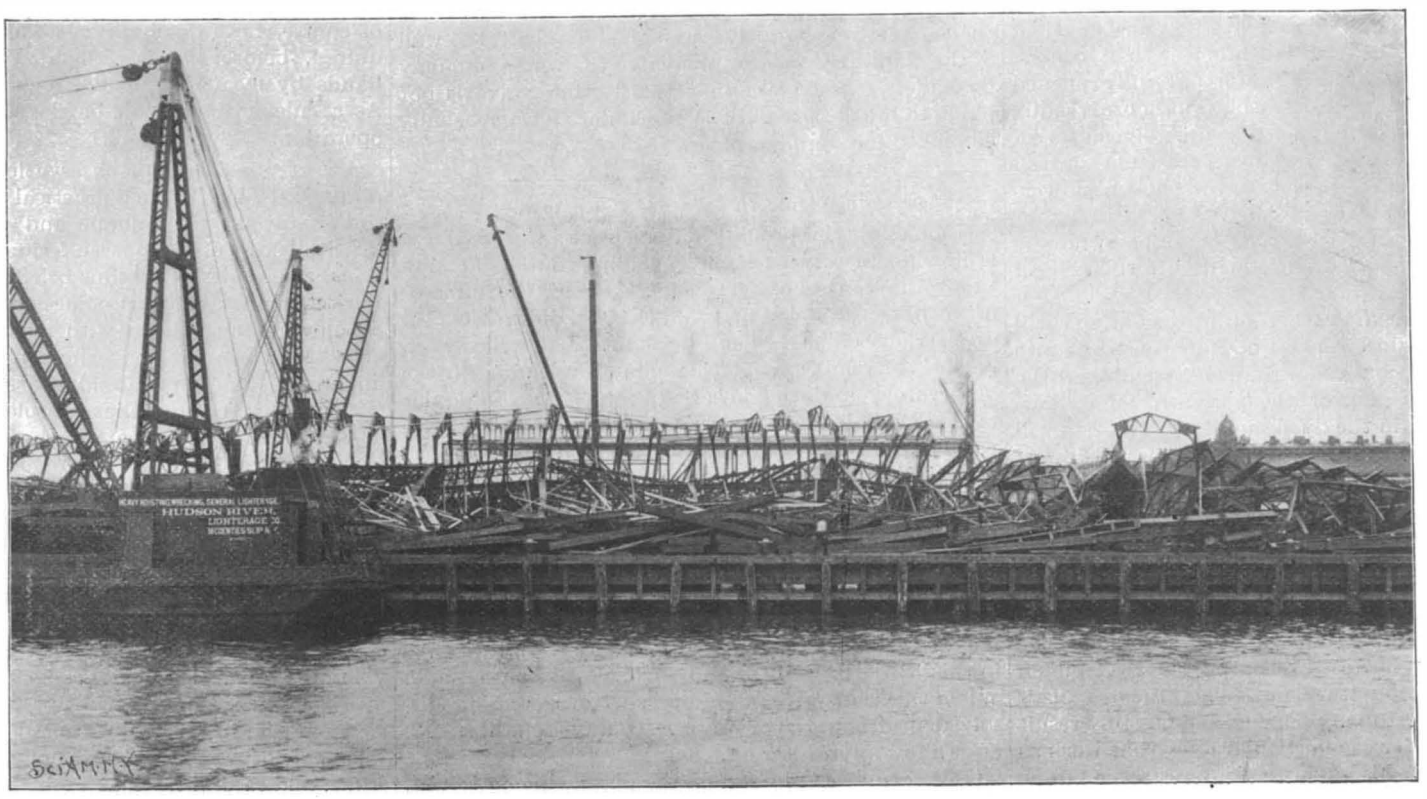
DETAIL VIEW SHOWING FRACTURE OF ONE OF THE POSTS IN PIER SHED.

The structure was two stories in height, the height from the first or pier floor to the second floor being 25 feet and the height from the second floor to the under side of the roof trusses being 16½ feet. The total height from the pier to the roof of the lantern was 63 feet. The walls consisted of built-up columns, spaced with an average distance of 22½ feet between centers, and tied together with two lines of horizontal struts of rectangular section, one at the second floor level and the second line at the top of the posts.

The second floor was carried on transverse plate girders 4 feet deep, one at each bent, the girders being riveted to the posts and the connection being stiffened by plate knee braces. The roof, which was of 120 feet span, was carried on lattice trusses which were supported at each end upon and riveted to the posts, open lattice knee braces being riveted at the connection to both trusses and posts. At the center of each main truss was the framing of the lantern, consisting of two posts and a smaller lattice truss of 35 feet span, raised 10 feet above the hips of the main roof trusses.

The columns were tied together longitudinally by two lines of box struts extending between the bents. The upper line, 10 inches in depth, was riveted to the columns just below the roof trusses, and the lower line, 12 inches in depth, was riveted to the columns at the level of the top of the plate girders that carried the second floor. The roof trusses were also tied together by two lines of longitudinal lattice trusses located at the hips of the trusses, that is to say, in the plane of the side walls of the lantern.

Now, in respect of lateral wind bracing, the structure was well provided, the knees uniting the floor girders and the roof trusses to the columns and the riveting of these girders to the columns giving the necessary stability; but in respect of lateral bracing, especially during erection, when the wind was able to take hold of every individual truss and floor girder, the whole structure was altogether deficient. The only resistance presented by the metallic structure itself to the overturning of the fourteen bents that had been erected was the holding power of the rivets and angles by which the longitudinal struts were riveted to the columns. The nature of the attachment of the bases of the columns to the pier was such that they presented very little resistance to overturning. It consisted of four 1-inch lag-screws, which passed through holes in the corners of the base plate, and fastened it to the flooring of the pier. It is true that some attempt to stiffen the structure had been made by introducing temporary 6 by 6-inch timber struts between the bents, the struts bedding against chocks of wood spiked to the floor and



WRECK OF A STEAMSHIP PIER SHED AT NEW YORK CITY.

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against the lattice work of the columns, and the westernmost bent was secured to the pier by two 1-inch wire rope guys; but, when the storm struck the building, the ropes broke and the chocks were either sheared off or the struts collapsed by buckling.

When a building of this kind has been sheathed, the longitudinal overturning moment is that due to the pressure on the end of the building, and it is resisted by every longitudinal riveted connection throughout the length of the structure. But, should a storm strike it before the sheathing is put on, the total overturning moment is that due to the action of the wind on the total area of every post, girder, and truss in the naked structure. The overturning moment in this case is far greater than it is on the completed building, and if the storm be of unusual severity, the building is in great danger of overturning and folding up, as in the case of the structure in question.

A study of the photograph, showing the fracture of one of the posts at its point of connection with the longitudinal waling members, shows how great was the wrenching effect at this point.

The fact that the Cunard Line shed did not fall is due either to the fact that it is only 60 feet wide, and presented not much over one-half the area to the storm that the fallen pier did, or that a gust of special violence struck the wrecked structure.

The accident, as a whole, emphasizes the necessity for providing ample longitudinal bracing in buildings of this character during erection, and, indeed, in all skeleton structures, whether they be low train or pier sheds or lofty office buildings.

### Green Carnations.

Mr. S. W. Williams, of East Orange, N. J., having seen a quotation from The Gardener's Chronicle, regarding the staining of carnations, undertook some experiments to determine its correctness and kindly sends The Druggist's Circular the following report:

"Acid wool green B will answer the purpose. If the stalks of white carnations are allowed to stand for a few hours in a solution of this dye, the color is readily taken into the circulation, following the veining of the petals and producing a beautiful effect. Any depth of color from the faintest tint to a brilliant green may be obtained by varying the strength of the solution. A comparatively strong solution usually has the effect of giving a rich green border to the petals, with a more delicate tracing of the veining toward the center of the flower. Dilute solutions give a more natural effect. Naphthol green B acts slowly, but gives a very pretty tint.

"There are very likely many other green dyes which will answer the purpose, and perhaps better; but the writer tried malachite green, direct green, and a number of others with negative results. An 'acid' yellow worked with indigo carmine may be made to produce colors ranging through apple to the more yellow greens, while the same blue used in combination with the wool green should give bluish greens.

"The Circular certainly did its part fully in securing the statement of an expert in this line. It is easy to understand how his actual experiments were misleading. Of the many dyes tried by the writer, but about one in five was taken into the circulation of the plant. One theory to account for this is that 'basic' dyes may be intercepted by tannins or other incompatible principles in the stalk, whereas 'acid' colors may be allowed to pass on to the flower. As a number of 'acid' dyes failed, however, to enter the circulation, the writer would seek to offer no explanation without further study. It is strange also that, of several flowers of the same kind placed in the same solution, some appropriated the color much better than others. One theory for this is that a flower not fully opened would naturally draw up the solution more readily than another which had more completely matured. The writer's experiments, however, have not proved this to be necessarily so, nearly full blown flowers seeming to act about as well as any.

"As to the comparative lasting qualities of flowers thus treated, some seem even superior in this respect to those not dyed.

"Crocein scarlet, in rather dilute solution, will readily change a white Alaska or Harrison white into a beautiful pine carnation, much resembling the 'daybreak,' the veining of the perianth being, however, more marked in the dyed samples. This dye will pass four or five joints in the stem and color the flowers pink within an hour, acting far more rapidly than most of the other colors.

"Cyanole, extra, works satisfactorily where a blue tint is desired.

"While this question is outside the domain of pharmacy, to whom will the interested citizen more naturally go for information on the subject than to the pharmacist—the 'chemist to the people'? A bunch of artificially colored natural flowers, on the druggist's counter, will interest many persons and possibly result in numerous calls for the particular dyes that work so well. Anything of this kind that interests the public leads people to ask questions and to want material which will enable them to produce the same effects, and should afford a good and legitimate means of advertising.

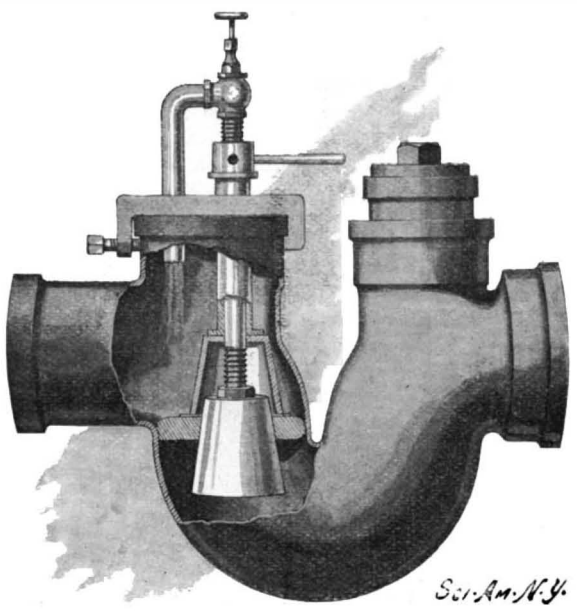
"An East Orange florist informed the writer that about seven years ago a Long Island man launched the green carnation on an unsuspecting public, and, while others were charging a dollar per hundred for carnations of natural color, this man was getting about two hundred per cent advance for his dyed flowers. When it was found how the thing was done the craze died out; but as the same thing seems to have appeared again on the scene, and, considering that a metropolitan florist is not quite familiar with it, the idea will doubtless excite considerable interest on the part of the general public.

"We are told that, when Nature paints, she dips her brush in iron, and it is said that iron in the water used or naturally present in the soil changes the color of one of the white hydrangeas. Experiments with some of the inorganic salts might bring out some interesting points."

### A NEW TESTING VALVE.

We present herewith an engraving of a new valve for testing sewer pipes, which is the invention of Gottlob E. Loeble and Frederick Katzenberger, 45 Grand Street, New York city.

Referring to our sectional view, in which the valve is shown applied to a hand hole, it will be seen that the valve comprises an expansion ring made of rubber, mounted on an expanding block in the form of a frustum of a cone. The testing pipe forms the shank of the expanding block. This pipe communicates with the interior of the expanding block and extends up through a tube, as seen in the illustration. A valve controls the communication between this tube and the outlet pipe, which extends downward to discharge water through the hand hole into the outlet of the




LOEBLE AND KATZENBERGER'S TESTING VALVE.

trap. On the lower end of the tube is a hollow pressure block engaging the upper side of the expanding ring. On the upper end of the tube is a nut engaging with a thread formed on the testing pipe and having a series of holes to receive a handle. The device is held in position by a clamp.

After placing the valve in the trap, by turning the nut, the expanding block will be drawn up to force the expanding ring to a tight connection with the wall of the trap. By opening the valve the water test may be made. It is evident that this testing valve is not liable to break so readily as the inflated bags usually employed for stopping pipes.

### Vesuvius in Active Eruption.

Mount Vesuvius promises a dangerous eruption. Lava is flowing in torrents from seven new outlets in addition to the central crater. Prof. Tasconi, the director of the observatory, at first said that he did not expect any serious damage would be done. Later, however, part of the roadway from the mountain leading to the observatory and the lower station of the funicular railroad was destroyed by a lava stream and the observatory is considered in danger. The stream along the foot of Monte Somma burned the chestnut forests. From a spectacular standpoint the eruption is finer than any since 1872.

### Negative Varnish.

Dissolve eight parts of borax and two parts of carbonate of soda in 160 parts of hot water, and dissolve in this 32 parts of bleached shellac broken up small. When this is dissolved, add one part of glycerine dissolved in 160 parts of water. If any deposit forms after a few days, filter off.

This varnish can be run on the plate while it is wet, hence the plate dries once for all.—Dun, in Photo. News.

### Science Notes.

The bureau of police and health officers of Pittsburg, Pa., have placed conspicuously around that city printed signs requesting all persons not to spit on the sidewalks or street crossings, says Municipal Engineering. This effort is made in the interest of public health, and if it does not have the desired effect, an ordinance will probably be passed fixing a penalty for spitting on the sidewalks.

"The first attempt at scientific forecasting of the weather," says E. J. Prindle, in an article on "Weather Forecasts" in Appleton's Popular Science Monthly, July, "was the result of a storm which, during the Crimean war, November 14, 1854, almost destroyed the fleets of France and England. As a storm had raged several days earlier in France, Vaillant, the French Minister of War, directed that investigations be made to see if the two storms were the same, and if the progress of the disturbances could have been foretold. It was demonstrated that the two were in reality one storm, and that its path could have been ascertained and the fleet forewarned in ample time to reach safety."

In a recent issue of The American Journal of Science are given the results of tests of a large number of magnets made of self-hardening steel, now in common use for lathe tools. The object of these tests was to search for a material for standard measuring magnets, which would be as permanent as possible, and have a small temperature and induction coefficient. The experiments show that comparatively short seasoned magnets made of this steel have decidedly smaller induction coefficients than magnets of the same dimensions made of tool steel; the difference in the temperature coefficient is much less, but the advantage is still on the side of those made of self-hardening steel; the temperature and induction coefficients of long magnets of the two kinds of steel do not seem to be very different.

Few photographers seem to be aware of the immense force exerted by gelatine in its contraction. The thing is, however, well known to collotypists, often to their cost. If a collotype plate be over-dried, the power of the gelatine, in its contraction, is so great that it tears away the surface of the glass itself, breaking it up in peculiar fern-like pattern. The surface of the collotype plate is always ground, and it is that which gives so firm a hold to the gelatine that the glass is torn away. It is a curious fact in connection with the matter that different characters of gelatine produce a different pattern fracture. A brittle kind of gelatine produces a different pattern from that yielded by a tough and horny one. This property has been taken advantage of, commercially, for many years past in the manufacture of that kind of ornamental glass known as "crystalline glass," so general for decorative purposes. —British Journal of Photography.

The practice of Dr. Miculicz, professor of surgery at Breslau, is to wear gloves while performing most of his operations, and especially when engaged in laparotomy, but if, however, the intervention is connected with regions specially exposed to infection, he does not cover his hands, holding that gloves under such circumstances could only favor contamination, by helping to convey noxious germs from diseased parts to those still remaining healthy. Unlike some others, he makes no use of India rubber gloves, as he finds them embarrassing, but employs the ordinary thread article, which can be readily washed and sterilized under steam. All the assistants and attendants have also to wear gloves like the surgeon, but as thread gloves are, of course, far from impermeable, the wearers are required, before putting them on, to disinfect their hands by means of alcohol and corrosive sublimate. As a rule, a single pair of gloves suffices for a short operation.

An extended series of observations in La Pitié Hospital, Paris, has led to a practical determination as to the alterations, their shape and volume, which occur in the hearts of persons suffering from nervous affections, the results being thus briefly stated: In normal subjects moderate exercise does not cause any perceptible changes in the heart with regard to shape, volume, or position; in subjects whose nervous systems have undergone deterioration in consequence of hysteria, neurasthenia, or any reflex trouble having its point of departure in a special part of the organism, the heart grows hyperexcitable and changes in shape or position the moment it is called upon to do some slight extra work. This alteration may present itself in three typical ways, as follows: The whole cardiac area may be uniformly enlarged, or the increase may be partial and irregular; or the heart may become retracted and diminished in volume; finally, the organ may be dislocated laterally, with or without changes of shape and volume, the displacement being directed toward the mesial line, or, more frequently, toward the axilla. It is stated that in the prosecution of these researches use was made of a modified form of Bianchi's phonendoscope, and careful tracings were also executed, showing the contour of the heart region before and after exercise.

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## Correspondence.

### A Remarkable Rainbow.

To the Editor of the SCIENTIFIC AMERICAN:

I desire to call your attention to a most remarkable rainbow that I, with several others, witnessed on the evening of July 18, at about eight o'clock. We were near the little town of Eatonville, about thirty miles west of Mount Rainier, Washington, and in the timber. For a short time I could dimly discern five bows, or principally bands of red and purple, under the primary, making six in that group, and two of the secondary. Not only was the number larger than I have ever before witnessed or heard of and the colors brighter, but all of them were almost perfect semicircles, being complete throughout. We had no instruments for measuring, but a gradual decrease in width and brightness, like the bands in "Newton's rings," was quite apparent.

H. C. TILLMAN.

Puget Sound University, Tacoma, Wash., August 30, 1898.

### Theory of the Manner in which the Sounds of Flue Organ Pipes and all Classes of Reed Wind Musical Instruments are Produced.

To the Editor of the SCIENTIFIC AMERICAN:

It is, I believe, the general if not universal opinion that all sounds are produced by vibrations which are conveyed to the ear by the atmosphere. How those vibrations are started and kept up has not been explained to me in a satisfactory manner.

Helmholtz, in his work, "Sensations of Tone," Part 1, Chapter 5, states that the stream of air in a flue organ pipe is directed across the sound hole and against its sharp edge, producing sounds which may be considered as a mixture of several inharmonic tones of nearly the same pitch. When the air chamber of the pipe is brought to bear upon these tones, its resonance strengthens such as correspond with the proper tones of that chamber, and makes them predominate over the rest.

In Appendix 19, Part H, Chapter 6, of the same work, a different theory is propounded by Mr. Herman Smith and Herr H. Schneebeli. Smith claims that the stream of air does not impinge against the sharp edge of the sound hole, that vibrations are produced by a form of "aero-plastic reed," which is formed outside the pipe, and bends partly within it, and that this reed acts similarly to the reeds of other wind instruments in the following manner: "The stream of air exhausts the air back of the reed, as shown in the atomizer drawing up a stream of liquid, thus effecting a vacuum, alternated by a pressure from the air rushing in, and causing a vibration of the reed."* This hardly seems plausible when we consider that some notes of a wind instrument require over 4,000 vibrations per second. It seems impossible that in a body as elastic as air this number of vacuums could be made and filled in a second, and that the opening or closing of the lateral holes could change the pitch of the sounds produced.

This theory of Smith's is the only one I have seen that attempts to explain how such vibrations are caused, but this only applies to the flue pipes of an organ, to the flageolet, or to the flute. Neither will it explain how the wind causes the strings of an Æolian harp to vibrate.

Doubtless you have often noticed that in the time of a freshet, when a stream has overflowed its banks, some twigs and bushes that are almost buried in the water and in the current of the stream are in constant vibration. This vibration is not governed by the velocity of the current as much as by the length and elasticity of the vibrating portion, for different twigs exposed to currents of the same velocity may vary in the rapidity of their vibrations. Another peculiarity is that the vibrations are not with and against the current, but transversely across the current. I believe that the same laws which produce vibration of a twig in a current of water produce the vibration of the Æolian string in a current of air.

The theory which I now advance is based upon the supposition that a peculiarity that is known to exist in any fluid in motion will be found in any other fluid. The action I now refer to may easily be seen in a thick, viscid liquid like tar or thick molasses. If you let a thin stream of such a liquid fall on a fixed body, you will at once see that the lowest portion of this stream bends back and forth, in what I call a lapping manner, some four or five times a second. I estimate that the mobility of pure water is thirty times greater than that of thick tar or molasses, that the vibrations would be thirty times greater, or from 120 to 130 times per second, and as the arc of vibration may be thirty times less, such vibrations would not be visible to the unaided eye.

To return to the stream of tar, if you allow it to fall on a piece of board, and at the same time move the board, the lower part of the stream will cease lapping and string out to one side like a kite string. If you reduce the speed of the board to a certain velocity, the lapping will commence, but the laps will be unequal, the long legs will be in the same direction the board is moved. In the case of the vibrating twig or Æolian string it is only that portion of the current that is about to impinge or has impinged against the twig or string that is caused to lap and to push the twig or string until its elasticity arrests and reverses its motion. The moment the retrograde motion commences the long laps change to the opposite side and assist the elasticity to move the twig to and past its normal position. I estimate that the vibrations of a stream of air impinging against a fixed body will be thirty times that of water having the same velocity, or from 3,600 to 4,500 vibrations per second; and if the velocity of the air is doubled or tripled, the vibrations will be increased in the same ratio, making the vibrations greater than necessary to produce the highest note that can be made on any wind instrument.

In the common whistle, flue organ pipe, flageolet, flute, and similar instruments, it is the lapping of the stream of air when it strikes the outer lip of the sound hole that puts in vibration the column of air within the pipe or tube and produces the sound. The moving of the sound wave within the pipe is governed by the length of the column of air, and this movement of the sound wave has the same effect on the lapping of the stream of air as the moving of the board has on the lapping of the stream of viscid liquid, and shows why the pitch of a flue organ pipe is governed by the length of the column of air above the sound hole, and how the opening and closing of the lateral holes of the flute make it possible to produce the chromatic scale.

In the free and beating reed class of instruments the current of air is in the same plane as the flat or inside surface of the reed. Whether the friction of the air against the inside surface of the reed or that which impinges against the edge of the reed causes the lapping or whether the two opposite currents from both sides of the reed impinge against the other and cause a lapping is not material. I think it is one of the three, or perhaps all of the three, that produces the lapping that causes the reed to vibrate. In the double reed the current of air impinges against the edges of the reed, or the friction against the inner walls of the reed causes a lapping and the reed to vibrate.

Some writers think that the lips of the player on a horn act similarly to a double reed, or, in other words, form a double reed. There is no doubt that they do vibrate with great rapidity. Regarding the lips as a double reed, it is the friction of the air against the lips that causes the stream of air to lap, which sets the column of air within the horn in vibration.

E. H. HAWLEY.

Washington, D. C.

*For a fuller description of Mr Smith's theory, see Nature, Vol. 8, pp. 25. 45; Vol. 9, p. 301; Vol. 10, pp. 161, 481; Vol. 11, pp. 325, 425; Vol. 12, p. 145; and Vol. 13, p. 571.

### Armor on Warships.

To the Editor of the SCIENTIFIC AMERICAN:

I have been much interested in the accounts of our navy and its armament given in your SUPPLEMENTS.

According to them, the Harvey armor has an extremely hard face, but the hardening process only affects the steel for an inch or two in from the surface, and the rest of the plate has no more resisting power than so much tough steel. At first, when the projectiles struck the hardened face, their points were shattered and they failed to get through. This was met by protecting the point of the projectile with a soft steel cap which kept the point from breaking up, thus allowing it to penetrate the armor.

Were the armor to consist of two plates of the Harveyized armor, set one behind the other with an air space between them, would not these results follow?

First.—The projectile would have twice the depth of hardened steel to penetrate and a less thickness of armor would be required for the same resistance.

Second.—The soft cap would disappear from the projectile on its impact with the outer plate, and it would have to penetrate the second plate without the advantages accruing from the soft cap.

Third.—The lightening of the vessel. Such a double, or even treble system would reduce the aggregate thickness of armor, and give opportunity for a heavier armament or larger coal supply.

The space between the layers is evidently important, as guarding against the possibility of the outer plates taking the place of the soft cap in enabling the projectile to pierce the second.

I should feel obliged if you can express an opinion on the subject, either by letter or your correspondence columns.

C. W. KELLOGG.

Vineland, N. J., September 2, 1898.

[The system of disposing the armor in two separated walls is nothing new, for it is adopted in such vessels as the "Brooklyn" and "New York," where a projectile would first encounter a belt of vertical armor and then a wall of inclined armor, forming what is known as the "slopes" of the armored deck The theory of this system of distribution is correctly stated by our correspondent.

The space between belt and sloping deck is devoted to coal bunkers, and the coal would assist in bursting and scattering and checking a shell before it reached the deck armor.—ED.]

### Miscellaneous Notes and Receipts.

**Green patina on zinc roofs** which lasts for years is produced in the following manner: Cleanse the zinc of all dirt and coat it repeatedly with a diluted solution of copper nitrate. When the whole roof has been thus coppered over, cover it with a likewise diluted solution of carbonate of ammonia. On this coat of copper, patina readily forms.—Maler Zeitung.

**Highly Expansive Enamels.**—Mr. Saglio reports to the Société d'Encouragement de l'Industrie Nationale the results of his researches on highly expansive enamels, which are as follows: 1. That silica, kaolin, petalite, and zircon impart to the enamel infusibility and insolubility, but lessen the expansiveness. 2. That calcic phosphate increases the expansiveness, gives viscosity to the enamel in fusion and imparts to it a certain insolubility. 3. That cryolite, fluorspar, and, above all, rutile (which seems to fix the boracic acid well), increase the expansiveness and the fluidity of the enamel.—Moniteur de la Bijouterie, etc.

**Absolute alcohol** has, up to now, been produced by treating ordinary alcohol with calcium chloride or caustic lime or barium oxide, etc., which substances remove the water from the alcohol. These processes are rather tedious and also entail a considerable loss. As reported by the Färben Zeitung, absolute alcohol can be obtained in a very convenient way by introducing calcium carbide into the ordinary alcohol. The latter is strongly attacked by the water contained in the alcohol, and acetylene is formed as long as water is present. For the separation of the resulting lime and the calcium carbide not attacked, the alcohol is subsequently evaporated. On the other hand, calcium carbide may be employed as a reagent, by means of which may be ascertained whether any more water is present in the alcohol or not.

**The Japanese Wood Oil.**—According to Emil K. Blumme, the Japanese wood oil is, both in China and Japan, principally obtained in large quantities by expressing the seeds of Aleurites cordata, and is utilized as lacquer as well as for illuminating purposes. Efforts were made to introduce it into Europe, and it might successfully be employed in the manufacture of lacquer and oil paints. It was examined by Cloëz about twenty years ago and recently by Davies and Holmes. It consists of oleine (red oil) and elaeomargarine (a glyceride of the acid $C_{17}H_{30}O_3$). The tree yielding the oil is in China called "ying tzu tung" (ying-bottle), on account of the bottle-shaped fruits. Aleurites cordata attains to a height of 20 to 25 feet, grows in rocky ground, and is chiefly found in Hunan, Hupeh, and Szechuen. The fruit, which contains from five to seven large, poisonous seeds, from which the oil is pressed, is gathered in August and September and sent to Hankow. The oil is obtained in the following manner: The dried nuts are thrown into a flat dish of about two feet diameter, and roasted over direct fire. They are next pulverized between stones, and squeezed in wooden presses, whereby the oil exudes, which is then strained. After the nuts have been freed from the oil, they are charred in China, thereby furnishing a valuable soot, which is utilized in the manufacture of "India ink." The oil, when freshly prepared, is said to be exceedingly poisonous, and is used for adulterating the Gurjun balsam (from Dipterocarpus turbinatus). Two sorts of wood oil, to wit, Canton oil and Hankow oil, are distinguished in China.

Glacial acid produced a turbidity at 47° C. When 5 grammes oil are mixed with 2 c. cm. sulphur chloride ($S_2Cl_2$), to which are added 2 c. cm. carbon disulphide ($CS_2$), the mixture congeals, after one and one-half minutes, into a thick, sticky paste, at ordinary temperature. This paste is not as hard as that obtained from castor or linseed oil. If 4 grammes of the oil are heated in a capsule 7 cm. wide, a film forms on the edge after fifteen minutes, and after two hours it is so thick that by reversing the capsule no oil will escape. The increase of weight was during an exposition of four hours—0·36 per cent an hour. When heating the oil with argentic nitrate ($AgNO_3$), a red-brown color ensued after fifteen minutes. Concentrated sulphuric acid produced a black lump in the oil, while nitric acid (D = 1·4) converted the oil, after two minutes, into a firm lump, which became dark and friable afterward.

If 1 gramme oil is dissolved in 5 c. cm. chloroform, and 5 c. cm. of a saturated solution of iodine in chloroform are added, a thick paste forms after a few minutes, while diligently stirring the mixture.

Analysis has furnished the following values:

| | |
|---|---|
| Density at 15 5° C. | 0·8385 |
| Congealing point, about | 17° C. |
| Hübl's iodine No. | 165·7 |
| Saponification No. (mg. of KOH) | 194 |
| Hehner No. (insoluble fatty acids) | 96·4 per cent. |
| Non-saponifiable parts | 0·44 per cent. |
| Reaction of the specific temperature | 372 |
| Free fatty acids | 3·84 per cent. |

The mixture of fatty acids showed:

| | |
|---|---|
| Congealing point | 37° C. |
| Melting point | 37° C. |
| Hübl's iodine No. | 150·1 |

—Chemiker und Techniker Zeitung.

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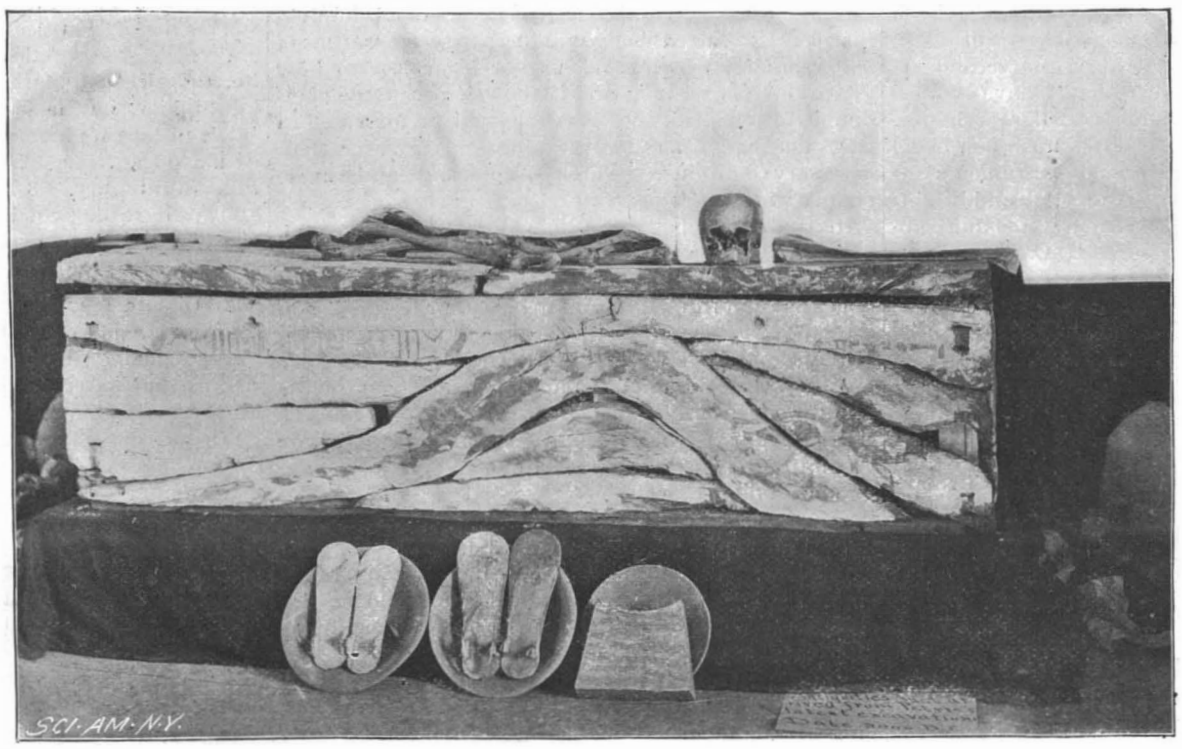
## A NEW LIGHT UPON THE EGYPTIANS.

BY WALTER L. BEASLEY.

It has been supposed that embalming the dead and converting the bodies into mummies was the earliest and universal mode of disposing of the dead among the ancient Egyptians. This long accepted theory has been almost conclusively overturned by the recent startling discoveries of Prof. Flinders Petrie, who has thrown fresh light on the methods of burial of the ancient Egyptians. During the excavations conducted by him at Deshasheh, about fifty miles south of Cairo, a series of old Mastaba tombs, dating back 3,500 years, were opened. On uncovering the lid of a number of wooden coffins, instead of the usual type of embalmed mummy being revealed, the dissected body of a woman, carefully wrapped in mummy cloth and linen, was disclosed, but the flesh had been entirely removed from the bones, unmistakably before burial. The uncovering of the mutilated flesh-scraped remains at Deshasheh ranks among the most astonishing archæological discoveries of the age, and goes far toward confirming the theory of cannibalism among the cultured Egyptians. The accompanying photograph shows the dissected portions of the body of a royal lady—a priestess—named Mery, lying on top of the original coffin in which her body was discovered. In the coffin was found a pair of wooden mortuary sandals and a head rest, on the sides of which were painted the name and title of the deceased noblewoman. The head rest was used to avoid disarranging the elaborate head dress and placed in the tomb along with her sandals for the use of the deceased. It is made of one block of sycamore, covered with a coating of stucco, grained to represent costly wood. The coffin, notwithstanding its nearly 5,000 years of entombment beneath the sands of the Nile, is to-day almost in perfect preservation, though somewhat injured during excavation and subsequent handlings. The various pieces were admirably fitted together, so that one sees the original almost intact. Down the middle of the lid and sides and ends are inscribed petitions of magical efficacy, which secure the deceased the satisfaction of all temporal wants, especially clothing, food, and drink. At the head and left side are painted a pair of eyes, which look toward the rising sun, and through which the deceased looked out. The coffin exhibits the form used in the old and middle empires. The material is sycamore wood, small pieces of which are fastened together by means of wooden pins into suitable planks, no large trees being found in Egypt. The corners are mitered and were fastened together by thorns countersunk inside them. The coffin was covered with a coating of stucco and decorated with a series of hieroglyphic inscriptions. There was found hanging up near the coffin a decorated panel or tomb drawing, which is particularly noteworthy from the fact that it is one of the oldest specimens of freehand work in existence. The picture is done in water colors, the pigments retaining their original color in a remarkable manner, while the execution shows considerable skill and knowledge of draughtsmanship. The picture dates back from the fifth dynasty, so that we are looking at the handiwork of an artist who lived some 5,000 years ago. The picture represents the sacred bark and rowers of the dead priestess Mery. The cord from which it was partly suspended from the wall of the tomb is still attached. Sets of amethysts and beads of the fifth dynasty were also found in the coffin. In a statue chamber of an adjoining tomb was found a limestone statue of a ruler named Nankheltka and his wife.




A NEWLY DISCOVERED METHOD OF DISPOSING OF THE DEAD IN ANCIENT EGYPT.

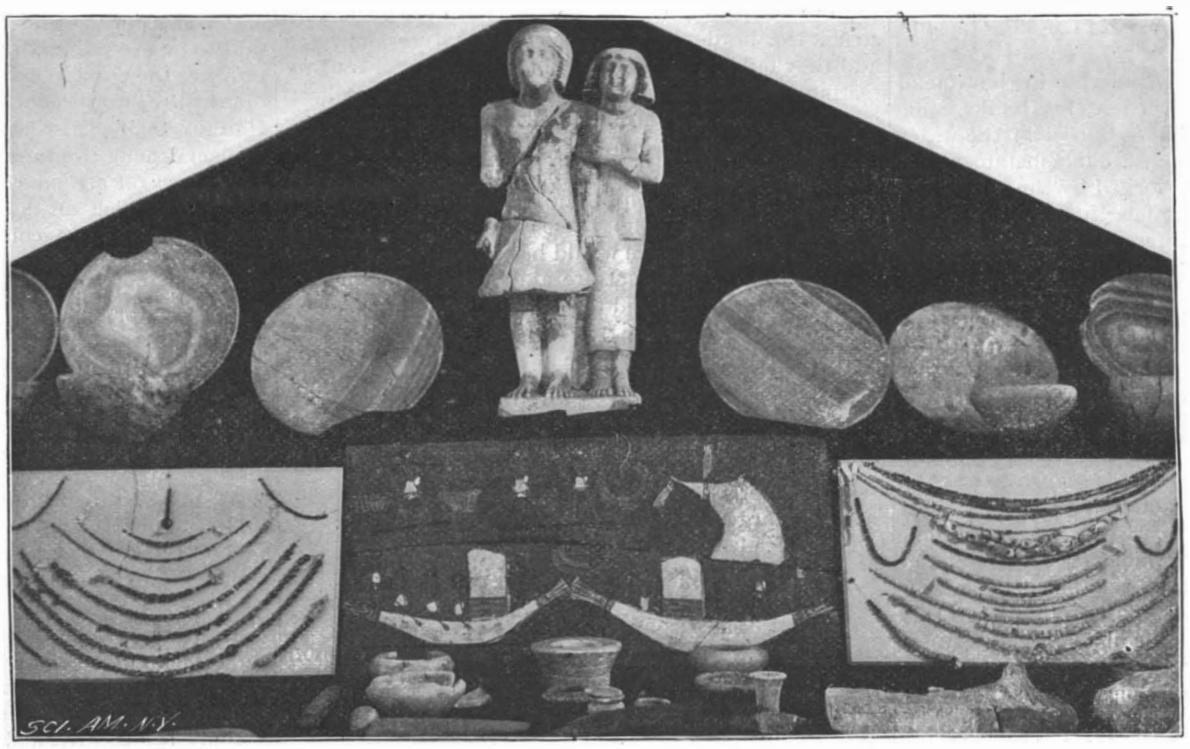
It is the opinion of Profs. Petrie and Brugsch that the custom of cannibalism was brought into Egypt by the Libyan invaders who occupied Upper Egypt about 3300 B. C. (See "Eaten With Honor," by Prof. W. M. F. Petrie, Contemporary Review, June, 1897.) They habitually cut up and dismembered the bodies of the dead, eating the flesh as a part of the burial ceremony to increase the eaters' own intellectual powers as well as imbibing all the magical attributes of the victim consumed. It will be, however, for future excavations to throw additional light and furnish positive proof whether the removing of the flesh from the body prior to burial was done as a ceremonial rite or a cannibalistic habit, pure and simple. The accompanying photographs were taken at the Haskell Oriental Museum, of Chicago, by the writer, where they and other antiquities have recently arrived, through purchase by the Chicago Society of Egyptian Research from the Egyptian Exploration Fund. Prof. James Henry Breasted, Egyptologist of the University, considers the collection by all odds the finest and most valuable which has yet reached American shores.

### Founder of the Red Cross.

To Mr. Henri Dunant, a Swiss gentleman, belongs the honor of inaugurating this movement, says Woman's Home Companion. Being in Italy at the time of the battle of Solferino, June 24, 1859, he visited the battlefield. Appalled by the needless and terrible suffering, he remained many days, doing all in his power to relieve it. During these terrible days Mr. Dunant conceived the idea of a system of organized relief whereby aid could be given under such circumstances. Returning home, he published a little book, called "Recollections of Solferino," that aroused great interest. His appeal touched a responsive chord in all hearts. Being invited to address the Geneva Society of Public Utility on the subject, he unfolded to them his plans. From that time forward he labored indefatigably to win adherents to his cause, writing articles, delivering addresses, traveling from place to place, consulting officials high in authority at the European courts. . . . By the provision of the Red Cross treaty, surgeons, nurses, ambulance trains, and all hospital supplies are considered neutral, provided they display a uniform badge and flag, accompanied by their national flag.

In compliment to Mr. Dunant and the Swiss government the protective sign and flag agreed upon was a red Greek cross on a white ground—the reverse of the Swiss flag. Turkey alone has objected to this. Her soldiers, in their intense hatred of the Christian symbol, refused to work under a banner with a cross, and they were allowed to use a red crescent in its place.

Mr. Dunant is now about seventy years of age. Having spent half his fortune in establishing the Red Cross, and having lost the other half in unfortunate business ventures, he lived for many years poor and forgotten, in a plain district infirmary in Switzerland, of which he himself was the founder. Now, however, through the pensions granted him by the Dowager Empress of Russia and the Federal Council of Switzerland, and the generous gifts of money sent him by the citizens of Stuttgart, Germany, he is spending a peaceful old age in comfort and plenty.




EGYPTIAN ANTIQUITIES, HASKELL ORIENTAL MUSEUM, CHICAGO.

### The Chinese Calendar.

The Chinese do not compute their time by centuries, but by periods of sixty years (luck shiapsix wood); each year in this space of time has its own name, partly relating to the five elements adopted by the Chinese sages, viz., wood, fire, earth, mineral, and water, partly connected with denominations of live creatures, such as rat, cattle, tiger, hare, etc. From the combination of these two factors into a double word results, at the same time, whether the year is a lucky or an unlucky one. If, for instance, wood and cattle meet in the name of a year, this signifies a good crop; fire and tiger prophesy a year of war. The year 1897 bore the name of dingh-dan—fire and fowl—and signifies a year of peace. The Chinese attach great value to these names, and are frequently governed in their enterprises by the fact whether the name of the year implies luck or bad luck. The division of the year is a twofold one, it being divided into 12 months and 24 semi-months. The latter bear the signs of the old Chinese zodiac, and are called rain-water, vernal equinox, pure light, rain for the fruit, morning flush of summer, little rainy season, seed of the herbs, summer solstice, commencement of the heat, great heat, sign of autumn, end of the heat, white dew, etc. Like us, the Chinese have four seasons (mua). The months have alternately 29 (weak months) and 30 days (strong months); frequently leap months are introduced for the sake of equalization. According to the Chinese calendar, there are also two kinds of weeks, some of 10 days and others of 15 days, so that a month is divided either into two or three weeks. The first days of the months are designated by numbers, but the first day is also called that of the weasel and the last one that of return, every day of the full moon being styled the day of hope. The night is taken at 7 hours, the day at 5. The counting of the 12 hours, each equal to two of ours, commences at 11 o'clock at night.

Frequently, however, the hours are also designated by animal names; thus the midnight hour is called the hour of the rat, while the midday hour is that of the horse. Each hour is divided into double minutes, minutes, and seconds.—Staats Zeitung.

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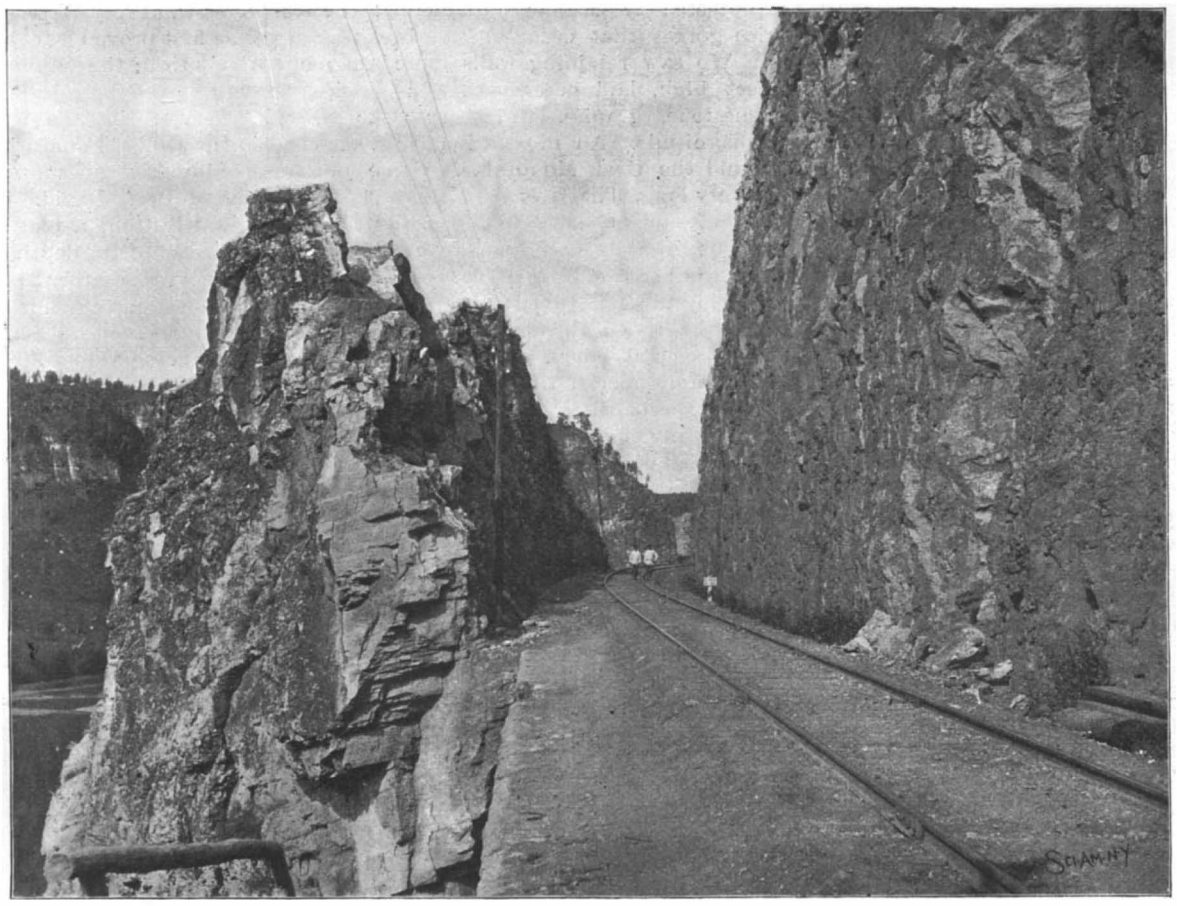
## THE TRANSSIBERIAN RAILROAD.

(Continued from first page.)

must say that it was agreeable and even necessary under the circumstances.

My object, however, is not to give incidents of travel, but to describe briefly the railroads themselves, especially the gigantic one that is now binding Europe and Asia together by bands of steel. As usual, the ubiquitous Yankee is in evidence, and undoubtedly had much to do with the introduction of railroads into Russia. This helps to explain the fact that many conveniences are found there which we look for in vain in other parts of Europe. But we were struck by one fact so decidedly unlike the American way that we sought an explanation, namely, that the road never hits any except the large cities, the station being usually several miles from the town or village whose name it bears. The explanation is that when two American engineers laid before a former Czar carefully drawn plans for a railroad from St. Petersburg to Moscow, touching at intervening cities, his majesty took a ruler, drew a straight line between the two capitals, saying like the autocrat that he was, "Build it there!" Of course it was done, and the example thus set was followed elsewhere throughout the empire.



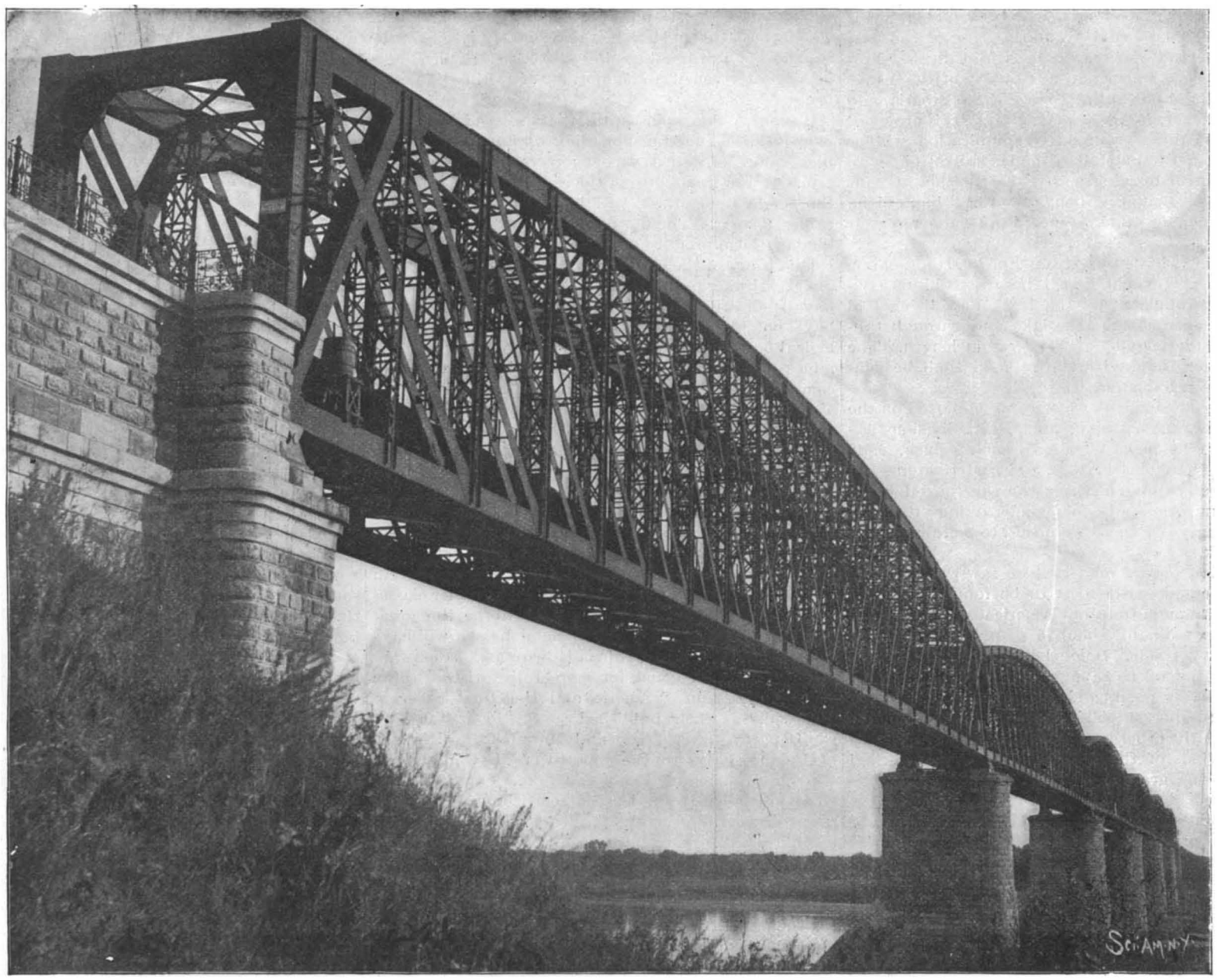
A RAILWAY CUT AMID THE URALS.

To understand the railway system one must first glance at the river system. The streams of European Russia mainly rise in the Valdai plateau, parts of which are 1,500 feet above the sea level, whence they sluggishly flow to the Arctic, Black, Baltic, or Caspian Sea. This immense river system, aided by canals, makes Russia in Europe accessible to St. Petersburg by 33,000 miles of navigable water, carrying last year 81,000 vessels and 140,000 rafts. Imagine a vast plain stretching for 1,800 miles from the Baltic Sea to the Ural Mountains, and for double that distance from the Arctic Ocean to the Caucasus, including vast forests, the rich black zone of "tschernoziom," then barren, treeless steppes, beyond which is the saline desert formerly the bed of an immense sea of which the Caspian and Aral are the remnants; and it is evidently a region favorable to the railroads which are now being built over it in every direction, to meet the varied wants of 115,000,000 inhabitants.

The Siberian river system, however, is different. All large streams, whether rising near the Urals or the Pacific coast, flow northward to the Arctic Ocean. Yet here, as in Europe, there are immense plains, so that the waterway from the river Ural to the mouth of the Lena, a distance of 6,000 miles, is interrupted by only two short portages. Hence this Asiatic region also favors easy railroad building, with the exception of the rugged hills and deep volcanic fissures around Lake Baikal, where the obstacles can only be overcome at a great outlay of money and labor.

From the times of Peter the Great to these days of Nicholas II., the great problem of Russia has been that of getting free access to the outside commercial world. The ports along the White and Arctic Seas are blocked by ice most of the year; the Caspian is landlocked; egress by the Black and Baltic can only be had by the friendly permission of other nations. Hence arose an imperative demand for a transcontinental railway that should wind over the steppes of Orenburg, the Ural plateaus, the plains of western Siberia, climb or pierce the hills below Lake Baikal, cross Transbaikal to the valley of the Amur, thence down to Vladivostok, on the Japan Sea, and ultimately to Port Arthur and the open Pacific Ocean.

This most extraordinary railroad undertaking could not all be done at once. Nor is it clear to every writer where the Transsiberian Railway actually begins. In 1878 the Ural line was built as far as Ekatherinburg. Four years later Ostrovski made surveys that met governmental favor, outlining a road from Perm to Tobolsk and thence to Irkutsk, his object being to open the mining regions. A line was also projected from Moscow across the tschernoziom belt to Oufa, where our Russian friends drew our attention to the splendid lattice girder steel bridge, over the river Bielaia, which is a subject of illustration, as a specimen of the work



TRANSSIBERIAN RAILWAY—STEEL BRIDGE AT OUFA, OVER THE BIELAIA RIVER.

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being done on their Transsiberian road. They likewise spoke of the charming city of Zlatoost as the starting place for that great railway. No more lovely situation can be imagined than that held by this busy mart and manufacturing city of 40,000 inhabitants, the last European station of any importance before crossing the boundary line into Asia. It is in the picturesque valley of the river Ai, whose waters here expand in a lake. But, so far as the Siberian part of the road is concerned, it is proper to speak of it as starting from Tcheliabinsk, where are the offices and works. But, after all, when ultimately completed, the main termini will be St. Petersburg and Vladivostok or Port Arthur.

The relation held to this continental enterprise by the reigning Czar is interesting. While Czarovitch he explored Siberia, went on to China as the guest of Li-Hung-Chang, and made himself master of every available source of information concerning the projected railway. The result was an imperial rescript, March 17, 1891, ordering work to be begun at several points simultaneously. The formal inauguration of it was by the Czarovitch, who wheeled away the first barrowload of soil and laid the first block of stone at Vladivostok. The Emperor also made him the first president of the road, a relationship which the latter continued to hold after he became the reigning Czar. The actual work of construction, however, was put in the hands of a committee in June, 1893, which is a branch of the Department of Ways and Communications; having only administrative power, the Emperor himself retaining executive authority.

The committee of construction divided the main line into seven sections, and estimated the cost of each as follows, although subsequent modifications were made both in the sections and estimates:

1. Tcheliabinsk to Ob, 1,328 wersts, cost 47,000,000 rubles.
2. Ob to Irkutsk, 1,745 wersts, cost 73,000,000 rubles.
3. Irkutsk to Misovskaia, 292 wersts, cost 22,000,000 rubles.
4. Misovskaia to Srjetensk, 1,009 wersts, cost 53,000,000 rubles.
5. Srjetensk to Khabarovsk, 2,000 wersts, cost 117,000,000 rubles.
6. Khabarovsk to Grafskaia, 347 wersts, cost 18,000,000 rubles.
7. Grafskaia to Vladivostok, 382 wersts, cost 17,000,000 rubles.

Thus the total distance between the Siberian termini would be 7,112 wersts (4,742 miles), and the total estimated cost 347,000,000 rubles (about $173,000,000)—although this cost will be much exceeded. At the time of our visit to Siberia we were informed that more than 5,000 miles of steel rails had been laid, at a cost of about 350,000,000 rubles, and the close of the year 1897 saw the road open as far as Nijni Udinsk. Now Irkutsk has been reached on a tributary of the Yenissei, the most important place in Eastern Siberia, and 3,780 miles distant from St. Petersburg. It is promised that by 1899 direct railroad communication will be open between St. Petersburg and Vladivostok, with the exception of ferrying across the treacherous currents of Lake Baikal, a body of water 466 miles long and about 55 miles wide, supposed to be the reservoir of numerous subterranean rivers.

The ferrying will be by a steamer of 4,000 tons, carrying the trains. Ultimately, this hazardous bit of navigation will be obviated by the track now being laid around the south shore of the lake and through tunnels, one of which will be 12,500 feet in length. The imperial order is that the entire road shall be completed between 1902 and 1905.

In 1895 the department reported as employed on the West, Middle, Transbaikal, and Ussuri divisions 36,629 navvies, 13,080 carters, 5,851 surface men, 4,310 carpenters, 4,096 stone masons, and 2,091 riveters—62,000 men in all. But such was the eagerness for the speedy completion of this undertaking that, in the following year, there were said to be fully 200,000 men at work.

The portion of the road that we saw was rock ballasted and equal to the best to be found anywhere in Europe; though, from our American point of view, the rails are too light, about 75 pounds to the yard, for the heavy traffic. Colonel Waters, of the British embassy, is quoted as saying, "The work done has been remarkably good, and in point of quality the line, when completed, will be equal to the Canadian Pacific." On the other hand, we were told, concerning certain portions of the road, that the ties were laid directly on the grass or sand, and that the work is being pushed along too rapidly. All agree, however, that the road, when finished, is to be as substantial as possible in every respect, and that it is to be equipped with every modern appliance for safety, comfort, and convenience.

Convict labor has been used on a large scale in the central section of the road, the terms being that eight months of railroad work should offset one year's imprisonment; and special offers of registration as peasants were held out as an inducement to exiles. Free labor was paid for usually at the rate of from 50 cents to $1 a day, according to skill required and the nature of the work to be done. Many, however, received less than this amount. It is not easy to estimate the great variety and quantity of labor needed for building this thoroughfare. For instance, the bridges involve very difficult engineering problems. They must be protected by peculiar skill against the tremendous ice gorges that occur at the breaking up of winter. We saw retaining walls more than one hundred feet high, laid in cement. The deep cuts through limestone, granite, and other rocks are of enormous magnitude. An illustration is given of a deep cut amid the Ural Mountains. Some of the bridges are very long. That over the Volga is 4,500 feet in length, and is said to be the longest steel bridge in the world. The river Ob is spanned by a bridge 2,500 feet long, and the Yenessei by one 3,000 feet long. The manner of testing these massive structures is to let four or more locomotives with a loaded train of cars stand on a bridge for several hours, and then to run them back and forth a number of times at a constantly increasing rate of speed, till the maximum is reached. The fuel used on the engines has been wood and crude petroleum. Coal has been found along the road near Pavlodai, allied to anthracite, and some of the seams in the Selenga valley are said to be thirty feet thick.

In December, 1896, the Cassini treaty was published, securing the right to build a Transmanchurian branch, leaving the Siberian road at Onon, entering China, running through Manchuria for 1,280 miles, and joining the original line at Nikolskaia on the Ussuri section, thus shortening the route about 350 miles. The significance of the Cassini treaty is that it really means a Russian administration of the affairs of Northern China, and that it will make the actual eastern terminus, not Vladivostok, but Port Arthur. This occupation of Port Arthur has been regarded as a Russian trick; but in reality it was a commercial necessity. As Count Mouravieff claimed last February, "It is natural that Russia should wish to have an outlet for her commerce on the coasts of the North Pacific." But he added, "Any such port would be open to the ships of all the great powers, and open to the commerce of all the world." We are apt to forget that 4,000 miles of Russian frontier touch China, and it is inevitable that the two nations should combine for the mutual protection of that long stretch. At all events, Russia, in March, 1898, formulated its final demand for the permanent lease of Port Arthur and Talienwan, as requiting her for her services in clearing the Japanese from China, and her claim was granted. As remarked by an English writer, "Had Port Arthur been called Fort Arthur, certain mistakes would have been avoided. It is a military point, and is to Talienwan what any fort would be to a port that it covered and commanded. The latter is destined to be the Russian Liverpool, the terminus of a railroad costing $250,000,000; and Russia must protect such an emporium of world wide commerce."

Of course this transcontinental railroad will enormously affect the transportation of Eastern goods of high value, as well as passenger travel and immigration. It is estimated that the revenue from duties on the single item of tea will be increased by 9,000,000 rubles a year. There will be a great output of all kinds of farm produce, and we should remember that Russia is one of the greatest agricultural regions on the globe. Mining products also will feel the stimulus and have such a development as will astonish those who have not given the matter due attention. Our geological party were impressed by the conviction that the mines of Russia are but very imperfectly worked, as compared with those of our own country, and are capable of yielding many fold what they now produce. And as to passenger rates, it is officially announced that the time from St. Petersburg to Vladivostok will be less than fourteen days, and possibly as low as ten; and that when all plans are worked out, the time from London to the Far East will not exceed eleven days, instead of the thirty now consumed by the trip via Brindisi and the Suez Canal. A ticket by the latter route now is sold for $428; but by the Transsiberian route it will cost only $119, first class, and other classes lower in proportion. Plainly this will be the great highway of the nations, and England herself will have to send her Australian mail via Moscow and Talienwan.

The reader is referred, for more full statistics, to the official report on "Siberia and the Great Siberian Railroad," recently published at St. Petersburg, by the Department of Trade and Manufacture, Ministry of Finance; also to the reports of M. Chilkov, the Russian Minister of Communication. This latter authority confidently predicts that, early in the twentieth century, the diligent "globe trotter" can girdle the earth from St. Petersburg around to St. Petersburg again in thirty-three days.

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LAVA streams that have flowed out of Vesuvius during the last three years have deposited 105,000,000 cubic meters of lava on the sides of the mountain. A cone of lava 330 feet high has been formed, out of which fresh streams are flowing. The valleys on either side of the observatory peak have been completely filled.

### Coral Reef Investigation.

In order to test the values of different theories entertained for the origin of coral reefs, borings have been made in islands supposed to be situated in regions of submergence. Reports have already been given in The Independent of those made by Prof. Agassiz, at Key West, and by Prof. Sollas, off Australia. The first proved the true coral rock to be comparatively thin; the second was a failure, because of accident to the boring tools. A committee of the Royal Society of England is continuing the work of boring in the atoll of Funafuti, one of the Ellice Islands, about five hundred miles north of the Fijis, under the direction of Prof. David. This is a circular island, rising solitarily from a plateau 2,000 feet deep. This boring had reached the depth of 653 feet, as reported by Prof. Bonney, November 25 last. The material to the depth of 200 feet corresponds very well to the ordinary reef. For 170 feet thickness lower down the cores represent substances produced in the vicinity of a reef. From 370 to 643 feet the rock is more like that first passed through. Work is still being prosecuted at this locality. Meanwhile, Prof. Alexander Agassiz has reached the Fijis with all the facilities for boring, and the intention of sinking a well at Suva, presumably to confirm the results attained by Prof. David. From a letter dated December 15 last, published in The American Journal of Science for February, it appears that Prof. Agassiz has made discoveries rendering another boring unnecessary. According to Darwin and Dana, it is impossible to find a better series of islands than the Fijis to illustrate the changes brought about by subsidence, there having been first an original volcanic island around which a fringing coral reef grew: next after sinking appeared the barrier reef; then an atoll; and, finally, one where there is only a more or less circular reefing.

After traveling some thirteen hundred miles throughout the archipelago, Prof. Agassiz has discovered that it is a region of elevation instead of subsidence, as he found numerous examples of elevated reefs at various levels up to 800 feet. Those are described in detail over about three-fourths of the archipelago. Not only are the reefs elevated, but they have been deeply eroded, producing gorges, separated by sharp, serrated ridges, thus bearing witness to the great length of time that has elapsed since their elevation. The conclusion is, therefore, that the corals of to-day have played no part in the shaping of the atolls among the Fijis, nor can the building up of the barriers be explained by submergence. The accumulations gathered by recent corals can form only a crust of very moderate thickness upon a base either of an eroded elevated reef or a substructure of volcanic material. The theory of Darwin and Dana cannot be applicable to the islands and atolls of the Fiji group; but we must rather accept the views of Murray, as illustrated in the reports of the "Challenger" expedition, which agree essentially with those of Agassiz. There may, however, be no general theory of the formation of coral reefs of universal application. With such divergent views as have been given us by the ablest naturalists, it would seem as if different regions might have been acted upon variously.

### A Brazilian Indian Telephone.

Mr. José Bach, in a narrative of his travels among the Indians of the regions of the Amazon, describes in L'Illustration an instrument by means of which these people communicate with each other at a distance.

These natives live in groups of from one hundred to two hundred persons, and in dwellings called "maloccas," which are usually situated at a distance of half a mile or a mile apart.

In each malocca there is an instrument called a "cambarisa," which consists essentially of a sort of wooden drum that is buried for half of its height in sand mixed with fragments of wood, bone, and mica, and is closed with a triple diaphragm of leather, wood, and India rubber.

When this drum is struck with a wooden mallet, the sound is transmitted to a long distance, and is distinctly heard in the other drums situated in the neighboring maloccas. It is certain that the transmission of the sound takes place through the earth, since the blows struck are scarcely audible outside of the houses in which the instruments are placed.

After the attention of the neighboring maloccas has been attracted by a call blow, a conversation may be carried on between the cambarisas designated.

According to Mr. Bach, the communication is facilitated by the nature of the ground, the drums doubtless resting upon one and the same stratum of rock, since transmission through ordinary alluvial earth could not be depended upon.

We have here an ingenious improvement upon the process employed by Indians for perceiving distant noises (such as the gallop of a horse), and which consists, as well known, in applying the ear to the earth. This method was formerly much used by the people under consideration during the course of wars of one tribe with another.

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## RAPID-FIRE GUNS AND AMMUNITION SUPPLY IN THE UNITED STATES NAVY.

In a recent article we promised to take up the question of rapid-fire guns and ammunition supply and show the present status of our navy in regard to these most important elements of the modern warship.

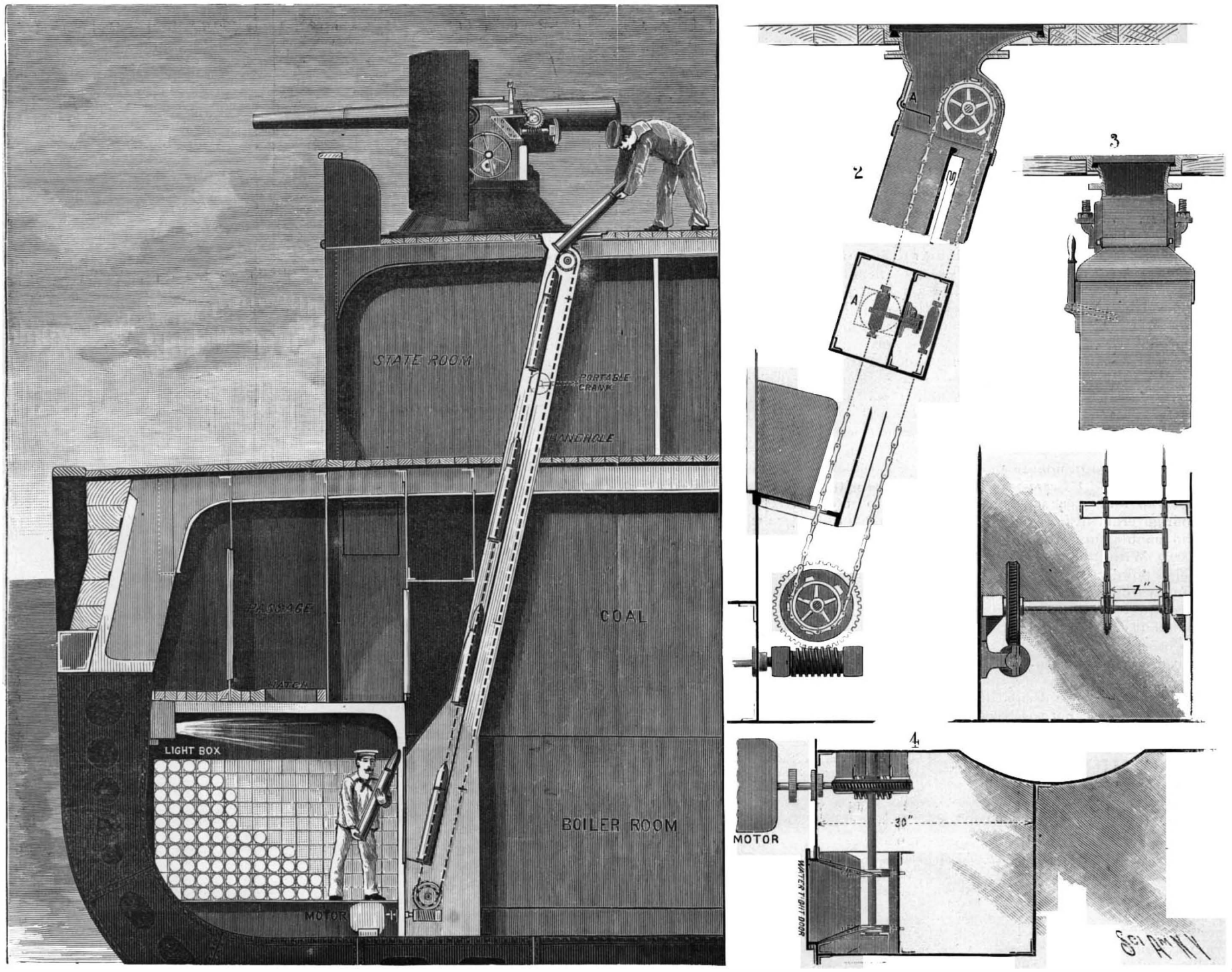
At the outset of the late war there was a mistaken impression among foreign critics that the United States Navy was severely handicapped by the lack of rapid-fire guns on its warships, and it was supposed that even on such vessels as possessed rapid-fire batteries the arrangements for the supply of ammunition were too faulty and slow to permit the guns being fired at their maximum speed. Neither of these assumptions was correct, and, indeed, so far from the navy being behindhand in the development of the rapid-firing principle, it is a fact that we were one of the first to experiment in this field and were only anticipated in the production of the 6-inch rapid-fire gun by the inability of our manufacturers to produce a satisfactory cartridge for the same.

Our greatest advance in the matter of armor and all the 4 and 5-inch rapid-fire guns in our navy. Regarding these mounts, which are illustrated on pages 13 and 15 of the ARMY AND COAST DEFENCE SUPPLEMENT, we take this opportunity of correcting an error in the titles of these cuts, which was occasioned by an ambiguity in the official publications from which the cuts were made. The mounts are there credited to Lieutenant Fletcher, whereas they were actually designed by Lieutenant Dashiell. Lieutenant Fletcher has been conspicuously associated with the later development of rapid-fire mechanism, and due reference to his work will be made later in the present article.

The first 4-inch rapid-fire guns to be built in this country were the Driggs-Schroeder and the Dashiell. As the Navy Department favored the slotted-screw system for its large guns, the Dashiell was adopted as soon as the gun passed a satisfactory test, which was in June, 1891. As far as mere rapidity of fire was concerned, the results obtained with this gun were superior to anything that had been accomplished abroad, as it was found to be capable of a sustained unaimed fire at the rate of 17 shots per minute. Work on the 4-inch

"The recently adopted breech-mechanism for rapid-fire guns of 4, 5, and 6-inch calibers has been put to a most thorough test with both good and defective ammunition. Four-inch gun No. 11 was fired 248 times. The breech-mechanism was worked about 8,000 times with tight-fitting cartridge cases. These cases had to be hammered into the gun, and were selected for the purpose of testing the extractor. There has been no failure in the action of any part. A test of rapidity of fire was made before the Chief of Bureau and bureau officers. Five rounds were fired in seventeen seconds, using experimental cases. Since then on two occasions five rounds have been fired in fourteen seconds. On the second trial the gun was laid at 10° elevation and all five projectiles were in the air together. Similar exhaustive trials have been held with the 5-inch rapid-fire mechanism. Five rounds have been fired in two instances in twenty-four seconds and twenty-two seconds respectively, without preliminary drill."

The 6-inch rapid-fire gun, with cartridge case, passed the development stage in the winter of 1894–95, since which time the 6-inch rapid-fire gun has become the




AMMUNITION HOISTS FOR SUPPLYING 4-INCH RAPID-FIRE GUNS ON THE MONITOR "PURITAN."

rapid-fire guns was made when Commander Folger, now of the U. S. S. "New Orleans," was the Chief of Bureau of Ordnance. It was his ambition to make every gun, including the 8-inch, rapid-fire in character, and that he did not accomplish all of his anticipations in this respect is owing to the fact that the private manufacturers, upon whom the government must depend for its supply of cartridge cases, were unable to manufacture cases of the size called for. The result was that, when Commander Folger resigned from the bureau in the winter of 1893, the 4-inch and 5-inch guns were the only calibers fully and satisfactorily developed, although the plans were already on foot for rapid-fire guns of calibers above the 4-inch and 5-inch, and for the manufacture and development of smokeless powder—that "open sesame" of the dreams of the rapid-fire gun inventor.

The early history of the development of the large caliber, rapid-fire gun in this country is also intimately associated with the name of Lieutenant R. B. Dashiell, Assistant Naval Constructor, United States Navy, who is the inventor of the excellent breech mechanism which bears his name, and of the mounts which carry guns was at once rushed at the Washington Navy Yard; and from that time on only the rapid-fire 4-inch was made, the old-fashioned 4-inch at once becoming obsolete. In the following fall the first 5-inch rapid-fire Dashiell gun was finished and tested. It gave results as much ahead of the foreign caliber as the 4-inch had done. It was at once adopted, and its manufacture was hurried as much as possible in order to arm ships of the "Detroit" and "Cincinnati" class. The "Olympia," flagship of Admiral Dewey at the battle of Manila, was also fitted with ten of these guns, and in that memorable fight there were no less than twenty 5-inch rapid-fire guns engaged. All of our vessels of the new navy carrying 4 and 5-inch guns have their batteries of the rapid-fire type and are fully up to date in every feature, except that of smokeless powder, and this indispensable element of rapid-fire efficiency has now been adopted as standard and will soon be in exclusive use throughout the navy.

As showing the excellent results obtained at an early day of the development of rapid-fire guns we direct attention to the report of the Chief of Bureau of Ordnance for 1892, which says:

standard of its caliber, and no more guns of the ordinary type are manufactured. Before the appearance of the 6-inch cartridge case as an article of commercial manufacture, Lieut. Dashiell endeavored to obtain rapid-fire results from a 6-inch gun by using a quick-acting mechanism with the De Bange gas check. By this means the gun-breech could be handled rapidly and considerable time saved in the service of the gun. As an example of what was done with a gun so fitted, attention is drawn to the same report of the Chief of Bureau of Ordnance for 1892, which says, in speaking of the experiments made that year with smokeless powder, "Besides the advantages of smokelessness and high velocities, the quality of leaving no dirt or fouling in the gun places at once the 6-inch gun with quick-acting mechanism among rapid-firing guns, even if using the service cartridge bag and the De Bange check and priming for each shot. As an example, before the Howell board, ten rounds were fired in two minutes and fifty-six seconds, sponging the chamber and wiping ou gast-checks after each round. The time for sponging was five seconds, for wiping out slope two seconds, or a loss of seven seconds due to the use of a

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powder with a residue. There being nine intervals in the ten rounds, one minute and three seconds would have been saved had smokeless powder been used, or the ten shots would have been fired in one minute and fifty-three seconds, which is as good if not better than the record of any foreign 6-inch gun with projectile of 100 pounds weight." At the time of these tests a test was also made of a gun fitted with the slow-fire mechanism, the conditions of firing being precisely similar for each gun. The gun with the ordinary slow-fire service mechanism took five minutes and two seconds for the ten rounds.

These experiments are of great interest in that they show that the ordinary delivery of a 6-inch gun was more than doubled by application of quick-acting mechanism, even without the use of smokeless powder, and that this result was obtained as far back as 1892. In 1897, five years later, the Vickers Sons & Maxim Company, of England, produced a gun on the same principle—a quick-acting mechanism with the De Bange gas check and no cartridge cases—with which gun they obtained a rate of fire of from seven to eight rounds per minute. This shows that so far from our Naval Ordnance Bureau being behind in the development of rapid-fire ordnance, it was, so far as the principle is concerned, five years ahead of what may be considered the highest development of the 6-inch gun in Europe. As the Vickers gun uses smokeless powder, the results obtained were considerably ahead of those which we achieved at our proving ground in 1892, for the reasons which we have already quoted from the report of that year.

The good work of Lieut. Dashiell has been supplemented by the excellent designs of later date by Lieut. F. F. Fletcher, whose rapid-fire mechanism is illustrated on pages 13 and 15 of the Coast Defence number of the SCIENTIFIC AMERICAN SUPPLEMENT. In this mechanism the breech is unlocked, withdrawn, and traversed clear of the breech by a single sweep of the lever acting on a very compact worm and rack device. To the same gentleman the navy is indebted for the quick-acting breech mechanism applied to its heavy 12 and 13-inch guns. This is a modification of a worm and rack device invented by a Frenchman named Farcot in 1880. His invention was not successful, as it could never be operated by hand power, and it was the modification introduced by Fletcher that made it a success. With this device the 13-inch breech has been opened in 8¾ seconds, and the time between rounds has been reduced to 1 minute and 47 seconds.

In connection with Dashiell's early experiments with a 6-inch rapid fire mechanism, it is interesting to note that our government has lately purchased the rights to use and manufacture the Vickers breech mechanism for $200,000. With this improvement and the use of smokeless powder added, our rapid-fire guns will stand in the very front rank for speed and efficiency.

In regard to the ammunition supply, there is no question but what the United States navy ranks ahead of any other navy in the world in the success obtained in delivering ammunition to the battery, at least so far as the rapid-fire guns are concerned. There is, of course, much yet to be desired in the delivery of ammunition in turrets, but the recent invention of Lieut. Haeseler, U. S. N., and its application to the "Texas" has shown what can be done in this line; for the delivery of ammunition to the "Texas" guns has been increased about six times by the adoption of plans prepared by this officer. The delivery of rapid-fire ammunition to all calibers of rapid-fire guns out of turrets has been developed along the lines tending to simplicity and immunity from disaster from the enemy's fire, and it has now reached such a stage that ammunition can be delivered at the gun as rapidly as the gun can fire it. As a matter of fact, the ammunition supply may be said to be excessive, because the maximum rapidity of aimed gun fire is attained only in volleys for intervals of not greater than three minutes at a time; whereas the ammunition hoist runs steadily as long as it is fed from the bottom.

All the hoists are of the endless chain pattern shown in the accompanying illustrations of the hoists to the 4-inch rapid-fire guns on the monitor "Puritan." The hoists consist principally of a trunk (see Figs. 2 and 3), about 18 inches square for 6-inch ammunition and less for the smaller calibers, in which runs a pair of sprocket chains with cross bars between them at intervals. The arrangement is practically an endless ladder with rungs about seven feet apart. The bottom of the trunk opens into the magazine, and the chains travel over sprockets at the bottom of the hoist and at the top just below the deck. The chains are driven by an electric motor through a worm and worm-wheel. The ascending half of the hoist passes in front of the magazine door, and here the men in the magazine take the cartridges from the racks and place them, one at a time, on the rungs or steps, by which they are carried up to the gun. The speed of the chains varies from one to two feet per second, and the delivery of the charges is from six to eight per minute for the larger rapid-fire guns. In the 6-pounder hoists of the "Indiana," boxes containing eleven rounds of ammunition have been delivered at the rate of seventeen boxes per minute. The trunks are made of such a width that they can be traversed by a shot, and, unless the chain itself be cut, the burrs thrown up by such a shot will not interfere with the passage of the round of ammunition, The upper end of the hoist is made flush with the deck and is closed with a flush scuttle plate, thus making no obstruction whatever on the deck above. The trunk is also closed with a watertight door in the magazine (see Fig. 4). A number of pawls (A, A, Fig. 2) distributed along the central guide plate in the trunk prevent the ammunition from falling in case the chain be shot away.

So effective is the system that, by a judicious arrangement of ammunition hoists throughout a ship, her whole ammunition can be delivered on deck in thirty minutes. It is needless to say that the battery could not deliver it at the enemy in thirty minutes, as no gun could stand the ordeal of continued firing for this period.

The accompanying table shows the relative number of 4, 5, and 6-inch rapid and slow-fire guns on the ships that are built or approaching completion in our navy.

The table shows we have a total of 318 rapid-fire guns against 68 of the slow-fire type. The 6-inch slow-firers are to be found on gunboats, such as the "Yorktown,"

| | Rapid-fire. | | | Slow-fire. |
|---|---|---|---|---|
| | 6-inch. | 5-inch. | 4-inch. | 6-inch. |
| Battleships | 60 | 28 | 6 | .... |
| Monitors | .... | .... | 10 | .... |
| Armored cruisers | .... | 12 | 12 | .... |
| Unarmored cruisers | 18 | 74 | 16 | 46 |
| Gunboats | .... | .... | 82 | 22 |
| | 78 | 114 | 126 | 68 |

and cruisers, such as the "Philadelphia" and "Baltimore," that were built before the era of heavy rapid-fire weapon, and have some of them been continuously in commission for several years. The policy of the department is to replace these weapons with rapid-firers the first time that the exigencies of the service permits the ships to return to the navy yards. The 6-inch slow-firers on the "Texas" and on the three battleships of the "Indiana" type are now being replaced with rapid-firers, and it is probable that within the next twelve months the last slow-fire gun will have disappeared from the United States Navy.

### The Current Supplement.

The current SUPPLEMENT, 1186, contains a number of papers of remarkable interest. "The Congo Railroad" is an illustrated article accompanied by a map which gives a detailed account of this great engineering work in the heart of Africa. "High Explosives and Smokeless Powder," by Hudson Maxim, is a very important paper by the great explosive expert. It is a paper which will be read with interest by all who are in any way interested in the ordnance of both the army and navy. The attention of our readers is called to the short notes which are given each week and which are also scattered through the paper. In the present number there are twenty-seven notes on a large variety of subjects. "Bull Fighting" is an article illustrated by engravings made from actual photographs in the bull-fighting ring. "Drinking Water at Camp Thomas" is a report of a sanitary engineer on the condition of Camp Thomas, Chickamauga, Ga. "The Significance of the Garment," by Alice C. Fletcher, is a paper read before the last meeting of the Association for the Advancement of Science. "Liquid Air" is a lecture delivered by Prof. G. F. Barker, of the University of Pennsylvania. This lecture has been revised by the author. The first installment is published in this week's issue of the SUPPLEMENT.

### Contents.

(Illustrated articles are marked with an asterisk.)


Ammunition hoist* ... 203
Books, new, etc ... 205
Business and personal ... 205
Calendar, Chinese ... 200
Canal, the Lake Erie and Ohio River ship ... 195
Carnations, green ... 198
Disinfectant, soap as a ... 195
Dock, floating, the largest in the world* ... 196
Egyptians, a new light upon the* 200
Engineers, our new possessions as a field for ... 194
Inventions, index of ... 205
Inventions, recently patented ... 204
Locomotives, draught attachment for* ... 196
Motor, tide* ... 196
Mount Ylimani ascended ... 195
Navy Department, forethought in the ... 194
Notes and receipts, miscellaneous 199
Organ pipes and reed wind musical instruments ... 199
Preservatives, food, dangers attending so-called ... 194
Rainbow, a multiple ... 199
Rapid-fire guns and ammunition supply in the United States Navy* ... 203
Railroad, Transsiberian* ... 193, 201
Red Cross, founder of the ... 200
Science notes ... 198
Shed, collapse of a pier* ... 197
SUPPLEMENT, the current ... 204
Telephone, a Brazilian Indian ... 202
Trade, South American, obstacles to ... 194
Transsiberian Railroad, the* 193, 201
Valve, a testing* ... 198
Varnish, negative ... 198
Vesuvius in active eruption ... 198


## RECENTLY PATENTED INVENTIONS.

### Mechanical Devices.

MOTOR CARRIAGE.—VICTOR ETIENNE PRETOT, Paris, France, has patented a motor carriage which he calls a fore-carriage. It is designed to be used in connection with any ordinary carriage in the same manner as horses. It consists of a very compact motor, operated by petroleum, and connected with the axle by an ingenious arrangement of differential gearing by which any desired speed and power may be applied. The mechanism for stopping, starting, and backing is simple and convenient.

TREAD-SANDING MACHINE.—GEORGE A. ENSIGN, Defiance, O. This invention relates to machines for truing and smoothing the treads of wooden vehicle wheels, and it is the object to provide a simple and durable machine for this purpose, which will enable the operator to perfectly smooth the tread of a wheel and render its peripheral surface square to the plane of the wheel. It consists principally of oppositely arranged abrading surfaces between which the tread to be acted upon is adapted to pass, and a revoluble standard for supporting and carrying the vehicle wheel and holding it between the two abrading surfaces.

JACK.—JOHN S. SCHLOSSER, Wadsworth, Ill. This jack is simple and durable in construction, easily applied, and conveniently manipulated. It is more especially designed for raising the felly from the spoke of the wheel to permit the insertion of a washer on the tenon of the spoke to insure a firm joint and to prevent the wheel from rattling. It is provided with a support adapted to be clamped to the spoke of the wheel. The support comprises a U-shaped member formed with sets of steps, the clamping member having a cam surface and pivot pins for engaging the steps. The jack is so simple in construction that it is not liable to get out of order and can be readily applied to any sized wheel for the purpose mentioned.

HAND DRILL.—JAMES MCSWEENY, Pittsfield, Mass. This invention is an appliance for regulating the feed of drilling apparatus, and is designed especially for hand drills. The drill spindle is threaded and carries a nut provided with a head by which the nut may be manually turned to hand feed the drill. Supported rigidly on the framing of the drill is a clamping device, by which the nut may be rendered fast with the frame, and, consequently, stationary with reference to the drill spindle. Then, as the spindle turns, the drill is fed with mechanical regularity by the action of the nut on the threads of the spindle. The several parts have such peculiar construction and are so combined that the device may be manipulated with ease and certainty.

VEHICLE-WHEEL.—JOSEPH BLAIS, Sherbrooke, Can. This invention relates to a vehicle-wheel, and has for its object means for tightening the tires on the rims of wheels. For this purpose a wheel with a double set of converging spokes is employed, by a novel mechanism. The inner ends of the spokes are moved toward and from each other, thereby increasing the diameter of the wheel at the rim.

AUTOMATIC FIRE-EXTINGUISHER FOR PASSENGER COACHES.—MAHLON MONROE WILLIAMS, Rico, Col. This invention provides a new fire extinguishing apparatus especially designed for use on passenger coaches. It is so arranged as to automatically extinguish the fire in the heaters, blow out the light in the lamps, or shut off the gas in the gas burners in case of a wreck or other accident, in order to prevent the coach from being set on fire. It includes a reservoir for compressed air for use in blowing out the lights and for forcing water into the fire boxes of the heaters, or shuts off the gas supply in case gas is used for illuminating purposes. Various means are provided for the automatic operation of the device in an emergency.

MACHINE FOR MANUFACTURING WELDLESS CHAINS.—JOSEPH MAYERS DAVIS, Glasgow, Scotland. This invention relates to a machine for the manufacture of weldless chains having open or unstayed links, with or without thickened ends, from a bar of cruciform section by a consecutive series of cold punchings and other operations. The bar of cruciform section is transferred into a series of unchained unstayed links, by being passed once through a machine actuating three sets of punches arranged to act at consecutive points. After the punching operation, which constitutes the initial stage of the manufacture, means are provided for bringing the links to a round section by stamping between dies and being compressed laterally to the desired form and dimensions.

ROCK-BREAKER AND ORE-CRUSHER.—FRANCIS H. COOK, Spokane, Wash. This new rock-breaker belongs to the class of machines for crushing ores in which an oscillating jaw is aranged opposite to the fixed jaw, the same forming two sides of a hopper. The movable jaw is actuated by an eccentric shaft. Adjustable crushing rolls are also provided to reduce the rock or ore to a fine state of division. The simplicity of the construction permits of a ready examinetion and cleaning of the parts.

APPARATUS FOR MIXING TEA.—In the old form of machine for this purpose, it has been usual to discharge the contents of the mixer through the charging aperture in the side of the drum into a receptacle below. To cause the contents to run out entirely, the drum is turned backward and forward several times to completely empty it. Mr. C. H. BARTLETT, Bristol, England, has patented a mixer in which these difficulties are avoided, and in which the teas are more thoroughly mixed. The mixing drum has a central discharge aperture and a chute connected therewith. After the mixing is done, the mixed tea is carried upward by the rotation of the drum and discharged upon the chute, through which it flows out of the machine.

### Railway Appliances.

CONDENSING LOCOMOTIVE.—Two patents have been recently issued to THOMAS J. MURRAY, of Butte, Mont., for a compound locomotive, which condenses the exhaust steam, heats the feed water, and in which the fuel is kept dry. This locomotive is capable of making a very long run, owing to the economy gained in both water and fuel. The entire locomotive is housed to prevent waste of heat and to protect it against snow, rain, and dust. The parts of the main frame which slide one upon the other are provided with ball bearings. The forward truck carries the cylinders. The boiler has a closed fire box, and the air for supporting the fire after being heated is drawn through the burning fuel by an exhaust fan in the smoke box. The exhaust steam is delivered to a surface condenser in which it is condensed and returned to the water tanks. The feed water is heated to a very high temperature and admitted to the boiler by gravity after the pressure in the heater has been equalized by the admission of steam from the boiler. The engine has many novel features, which need to be explained at length to be clearly understood.

NUT-LOCK.—JOHN R. HORN, Camden, Ark. This spring nut-lock device is intended to automatically take up the slack caused by wear of the angle or fish plates and bolts and at the same time positively lock the nut and absolutely prevent backward rotation of the nut when in use, while at the same time it can be easily applied and removed. The device consists of a steel bar or rod, having approximately the form of the numeral 8, with its ends both free and bent outward from the plane of the body portion of such device, one of the ends being beveled on its inner side.

### Agricultural.

VINE-TRIMMER.—GEORGE NORMAN JEUNE, Deer Wood, Minn. This new vine-trimmer is a machine especially designed for conveniently trimming strawberry or other vines or plants running close to the ground. It is arranged in a very simple manner to permit the user to conveniently move it over a field to cut up rooted as well as exposed vines. It comprises a shear or blade having a beveled, chiseled edge on the inclined forward end. The revoluble cutter is secured on one face of the shear or blade, and is operated in conjunction with the cutting edge at the top of the blade. Motion is transmitted to it from a wheel which is adapted to travel on the ground. The chiseled edge cuts the rooted vines, while the other vines are cut by the revolving cutter.

### Miscellaneous.

MUTE CLAVIER.—LOUIS ILLMER, Jr., Washington, D. C. This invention is an improvement in mute claviers for piano practice for use in studying the piano. It consists of an exercising apparatus provided with keys and with a rocking sounding device having a detent which moves into engagement with the key when the latter is depressed. Means are provided whereby if one key is depressed too far before the previously depressed key is released, the first key will be held by a detent, and if a key be depressed and then released before a second key is depressed, the action will, as the first key moves upward, strike a bell and indicate to the

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pupil his mistake. Therefore, the instrument indicates positively to the pupil whether the second key is depressed too fast or too slow with respect to the release of the first key, and enables the pupil to determine with accuracy whether the touch is properly cultivated.

ACCOUNT KEEPING BOOK.—THOMAS G. KNIGHT, New York City. This invention provides a new and improved account-keeping book designed for use as a collection account book and the like to enable the bookkeeper to see at a glance the standing of a customer. It consists of an account-keeping book provided with a plurality of leaves ruled for forming an account of a given period and divided into a column for names of the customers and successive equal monthly divisions, subdivided for keeping account of the new business for the month, the total balance, and for remarks, each leaf being provided with transverse perforations to permit a portion of it to be torn out and with apertures at each end and with fasteners for attaching the removed portion to another page.

TABLE AND DRAPERY-HOLDER. — ROBERT S. GANOUNG, Seneca Falls, N. Y. This invention relates particularly to devices adapted for connection with a table for supporting a canopy of drapery over the same, while the table is supporting a burial casket, and the object is to provide a device of this character which may be easily adjustable to height and also to so construct it that its several parts are detachable, so that the whole device, with the table legs, may be packed in the table top. In brief, the invention consists in a table adapted to support a burial casket, of a sleeve attached to the back rail of the table adapted to receive an adjustable rod, the rod being flattened on one side to engage a flattened portion of the sleeve. A standard is adjustable vertically with relation to the sleeve, and consists of telescopic sections and a bracket on the upper section of the standard. The apparatus may be adjusted to any height.

FIREPROOF PARTITION. — FRANCIS OMEIS, of Charleston, S. C., has secured a patent for a novel fireproof partition or wall, in which the studding or beams are formed of two metal plates curved and united to each other by rivets joining the central portion of the convex sides. When this beam is used as studding, it is secured at the top and bottom by angle plates. When a solid partition is built, wires extend through holes in the central part of the studding. Upon these wires are secured plaster-supporting webs of woven wire, or stamped sheet metal, and to this skeleton wall is applied plaster, which is built out until it covers the edges of the studding. When a thick, hollow wall is to be built, the wires are secured to the edges of the studding and a plaster support and plaster is applied in the same way as in the case of a lathed wall.

GRAIN-SEPARATING MACHINE.—C. E. CULVER, Cashton, Wis. By means of this machine, oats and other light seed and dust are separated from wheat rapidly and thoroughly, and the different kinds of seeds and the dust are discharged separately. The grain is delivered to a revolving drum having small pockets in its interior. As the drum slowly revolves, the grain is packed into the pockets by flexible strips, and a rotary brush brushes back the oats and dust. The grain in the pockets is carried upward by the cylinder, and the lighter materials, owing to the inclination of the cylinder, is made to discharge at the front while the grain is deposited on an inclined table down which it rolls. The small particles and seeds and the broken grain pass through perforations in the table and are delivered to one conveyer, while the grains of wheat are delivered to another conveyer.

DRY-KILN. — J. GUERRERO and J. UNGEMACH, Buenos Ayres, Argentina, have patented a dry-kiln, for quickly and thoroughly drying various substances. It is provided with inner and outer walls, and a furnace of novel construction for supplying the necessary heat. It has also an efficient system of ventilation by which the moisture expelled from the articles being dried is carried away. This drier can be used for many different purposes, but it is especially designed for the preparation of hung beef.

### Designs.

CARTON FILLER.—ROBERT J. BARKLEY, Chanute, Kans. The design consists in a filler presenting the appearance of a series of panels equally spaced from each other. The panels extend transversely of two longitudinal members which are disposed in proximity to each other and extend across the central portions of the first-mentioned panels, whereby narrow elongated openings appear between the members extending lengthwise between the adjacent panels.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for 10 cents each. Please send the name of the patentee, title of the invention, and date of this paper.

## NEW BOOKS, ETC.

**A POCKET BOOK FOR MECHANICAL ENGINEERS.** By David Allan Dow. With over 1000 illustrations. London, Bombay and New York: Longmans, Green & Company. 1898. Pp. 740. Price $2.50.

We learn from the preface that the preparation of the work has occupied the whole of the author's spare time during the past five years, and that he has also had the services of several assistants in the calculation of the tables and in the preparation of their illustrations, and we judge, from a cursory examination of the book, that the time has been well spent. It is a mine of valuable information presented in a terse form, easily understood by engineers. There are already a large number of engineers' pocket books, but there always seems to be room for one more, as engineering practice moves so rapidly. We could not undertake to give an outline of the contents in the limited space at our disposal, but, in brief, it may be stated, it includes mathematics, calculations and civil and mechanical engineering, with special attention to steam, pneumatic, and hydraulic engineering. The book is beautifully printed and the type is astonishingly clear. Illustrations are freely scattered through the book.

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WHAT TO SEE IN THE MOUNTAINS ON THE LOW RATES.

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Several hundred square miles of mountain peaks comprise the White Mountain region, and of the scores of resorts located in its midst space permits mention of but a few of the largest.

Many consider the vicinity of Dixville Notch the most beautiful part of the White Hills. The view of the surrounding territory is very beautiful, for lakes, mountains, brooks, and ravines are everywhere around, making an interesting landscape. In the Franconia region one finds many odd though beautiful attractions. There the Old Man of the Mountain stands guard over a galaxy of wild though particularly impressive bits of nature work. There is Cannon Mountain and Eagle Cliffs and Mt. Lafayette and Agassiz and Cleveland, while a short way off is Cherry Mountain, The Twins, and the Presidential Range, while natural curiosities like The Basin, The Flume, The Pool, and Echo Lake and Profile Lake are well worth visiting. Then, of course, all who go to the mountains want to visit the wonderland of New England, as that famous mountain pass, Crawford's Notch, is termed. Everything there is in its primeval state, and charming cascades, rushing forest stream and gigantic mountains make it the ideal place for the tourist, as well as the one seeking rest.

There are very many other sections of the White Mountains equally attractive as pleasure resorts, and at any of them you will find excellent accommodations, for the mountain hotels are every one of them models.

Beginning September 10 and continuing until about the 8th of October, the Boston & Maine Railroad will place on sale at many of its leading stations reduced rate tickets to all points in the mountains. The choice of several routes will be allowed, and for information apply to any station ticket office. Send to the General Passenger Department, Boston & Maine Railroad, Boston, for the book "What to See in the White Mountains."

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## Notes & Queries

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(7494) C. S. D. asks (1) for a formula for coating the back of a photographic dry plate to avoid halation. A. Powdered burnt sienna is used, mixed with gum and water. See SCIENTIFIC AMERICAN SUPPLEMENT, No. 1030. 2. Will this coating have to be removed before development? (I use Eikonogen developer.) If so, how? A. Yes; with a tuft of cotton or sponge.

(7495) S. M. R. says: Please answer through inquiry column the following: Formula for glue or paste which will adhere firmly, like the adhesive substance on envelops, at once it is applied. A. Postage stamp mucilage is said to be made as follows: Gum dextrine, 2 parts; water, 4 parts; acetic acid, 1 part. Dissolve with the aid of heat and add one part of ninety per cent alcohol.

(7496) J. B. asks: Could you tell me how to make the cement metal sign engravers use to fill in the letters with after they are cut? A. Melt together in a clean iron pot 2 parts each of best asphaltum and gutta percha; stir well together, and then add 1 part of gum shellac in fine powder. It may be used hot and mixed with smalt, vermilion or other pigment, if desired.

(7497) W. D. C. asks: Will water in small lakes, ponds, or large reservoirs evaporate when the humidity is at a high per cent as fast as at a low per cent, the thermometer and wind being equal in both instances? A. The term "humidity," as popularly used, means the relative humidity or degree of humidity, as compared with full saturation of the air with moisture, and not the absolute quantity of water vapor in a cubic foot of air. When the relative humidity is 100 per cent, the air contains all the water vapor it can hold. It can take no more, and water in ponds, etc., or in clothes hung upon a line, where humidity is 100, cannot evaporate at all. Under a high humidity, evaporation is slow; under a low humidity, it is rapid, other conditions being equal. Every housewife knows that on some days water does not boil away out of her kettles, and on other days it disappears rapidly. On the former humidity is high, on the latter it is low and the air is dry.

(7498) C. B. asks: 1. Can same size wire be used to wind motor of SUPPLEMENT, No. 641, for a dynamo, and if the same circuit is used? A. There is no difference in the winding of a machine to use it as a dynamo or as a motor. 2. Will a soft iron solid ring do for the armature? I use cast iron fields. A. You will have about one-half as much power with cast iron as with wrought iron. The design is made for wrought iron.

(7499) F. G. asks whether the direct or alternating current should be used in the electric arc furnace illustrated and described in a late issue of the SUPPLEMENT. A. Either current may be used.

(7500) W. R. A. says: 1. Can you tell me what photographers use to obtain the high gloss which some photos have? It seems to be a thin coating of some kind that is put on over the picture that gives it the appearance of glass. A. Use very clean plates and rather larger than the prints to be enameled. Wipe them well, rub them with talc, and remove the excess with a soft brush passed lightly over the surface. In a dish, half filled with ordinary water, immerse the photographs and allow them to soak. This being done, coat one of the talced plates with enameling collodion in the ordinary way, agitate to cause the ether to evaporate, and when the film has set—that is to say, in a few seconds—steep this plate, the collodionized surface up, in a second dish containing pure water. Now take one of the prints in the first dish and apply the printed side to the collodion, remove the plate from the dish, keeping the print in its place with the finger of the left hand, and remove the air bubbles by lightly rubbing the back of the photograph with the forefinger of the right hand. Care has been taken beforehand to prepare some very pure starch paste, passed through a cloth, and some thin cardboards, or simply thick paper, the size of the plates used. The air bubbles having completely disappeared, and the perfect adherence of the print ascertained, dry with bibulous paper, and spread over the prepared cardboard on paper a coating of the collodion by means of a flat brush. Apply this sheet on the print, pass the finger over it to obtain complete adherence, and give it twenty-four hours to dry. At the expiration of this time, cut with a penknife the cardboard or paper ven with the print, and detach by one corner. If the plate has been well cleaned, the print will come off itself. We get in this manner a very brilliant surface, and as solid as that obtained by use of gelatine, which, as it is seen, is entirely done away with in this process. The prints are afterward mounted on thick cardboard in the usual way. It is possible, by mixing with the collodion some methyl blue, dissolved in alcohol (a few drops are sufficient), to obtain moonlight effects, especially if a rather strong negative has been used. For sunsets, make use of an alcoholic solution in coccinine. Wet gelatine prints are simply rolled down on clean ferrotype plates which have been previously rubbed over with a cloth having a very minute quantity of beeswax rubbed over it, the beeswax being almost entirely removed from the ferrotype plates by means of a clean cloth. The prints will come off readily when dry. 2. Also is there such a thing as liquid celluloid, and is it proof against heat and cold—that is, will either of them cause it to crack? I have taken your paper for four years, and think it is the best in the world. A. There is a celluloid varnish called "Roxyline Enamel," sold by dealers in photographic materials, which is practically liquefied celluloid. Temperature will have little effect on it.

(7501) M I. M. asks for the composition for birdlime. A. Boil the middle bark of the holly, gathered in June or July, for six or eight hours in water, until it becomes tender; then drain off the water and place it in a pit under ground, in layers with fern, and surround it with stones. Leave it to ferment for two or three weeks, until it forms a sort of mucilage, which must be pounded in a mortar, into a mass, and well rubbed between the hands, in running water, until all the refuse is worked out; then place it in an earthen vessel and leave it for four or five days to ferment and purify itself. Remarks: Birdlime may also be made from mistletoe berries, the bark of the wayfaring tree, and other vegetables by a similar process. Should any of it stick to the hands, it may be removed by means of a little oil of lemon bottoms or turpentine. Use.—To rub over twigs to catch birds or small animals. It is said to be discutient when applied externally.


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# INDEX OF INVENTIONS

**For which Letters Patent of the United States were Granted SEPTEMBER 13, 1898,**

**AND EACH BEARING THAT DATE.**

[See note at end of list about copies of these patents.]

Abrading material, roll of, T. E. Keavy ..... 610,761
Aerial ship, T. J. Brown ..... 610,843
Air compressor, tide water, D. Becker ..... 610,790
Air compressors, air inlet valve for, J. G. Leyner ..... 610,608
Alarm. See Burglar alarm.
Back pedaling brake, J. Harrington ..... 610,649
Back pedaling brake, L. L. Williams ..... 610,696
Balcony, portable, R. Bahnsen ..... 610,517
Baling press, W. H. Young ..... 610,731
Bar piling mechanism, L. A. Treat ..... 610,749
Barrel press, A. J. Underhill, 2d ..... 610,592
Barrels to stocks, means for detachably uniting, W. Mason ..... 610,765
Basket, folding, M. Bach ..... 610,787
Basket for catching sewing from machines, M. C. Arrick ..... 610,854
Bath trap, W. H. Cloud ..... 610,800
Battery. See Stamp battery.
Bedstead commode attachment, E. Hummel ..... 610,863
Bedstead, metallic, E. Zambusky ..... 610,698
Bending machine, G. Guild ..... 610,585
Bicycle, J. F. Foster ..... 610,582
Bicycle air brake, J. H. Bowman ..... 610,796
Bicycle bundle strap, L. Levi ..... 610,847
Bicycle handle bar, C. J. Dieterich ..... 610,736
Bicycle handle bar, H. N. Ridgway ..... 610,748
Bicycle hanger, J. L. Martin ..... 610,656
Bicycle saddle, W. S. Smith ..... 610,614
Bicycle support, G. Hipwood ..... 610,536
Bicycle wheel, G. Hayes ..... 610,743
Bit. See Overcheck bit.
Boat, life, F. N. Lyons ..... 610,547
Boiler. See Steam boiler.
Boiler cleaner, J. J. Crall ..... 610,703
Bolster spring, J. F. Bohler ..... 610,841
Bolt, J. H. Williams ..... 610,638
Bone cutter, green, H. A. Hannum ..... 610,531
Bottle, J. Van Develde ..... 610,695
Bottle, lock, Betjemann & Caudland ..... 610,794
Bottle, non-refillable, L. de Nucci ..... 610,874
Bottle stopper, C. De Quillfeldt ..... 610,721
Bottle stopper guard, J. A. Hensler ..... 610,535
Bottles, jars, etc., cap for, Long & Jones ..... 610,715
Box. See Journal box. Paper box.
Brake. See Back pedaling brake. Bicycle air brake. Car brake. Vehicle brake. Warp beam brake.
Bridge, draw, E. C. Akers ..... 610,575
Bronze, crystal aluminum, J. T. Cupper ..... 610,645
Brush or dauber, blacking, J. C. Wickers ..... 610,750
Buckle, suspender, C. W. Latimer ..... 610,545
Buffing machine, T. E. Keavy ..... 610,759
Buffing machine buffer, shoe or other, T. E. Keavy ..... 610,758, 610,760
Buffing pad, T. E. Keavy ..... 610,762
Burglar alarm, J. W. Parrish ..... 610,826
Burning pulverulent fuel, apparatus for, C. A. Freitag ..... 610,845
Button, C. Radcliffe ..... 610,662
Button machine alarm device, H. T. Jenkins ..... 610,876
Buttonhole band, G. Boxley ..... 610,579
Camera, kinetographic, A. F. Parnaland ..... 610,560
Camphor, refining, W. Schmidt ..... 610,664
Can closure, milk, E. M. Peacock ..... 610,720
Can spout, R. Dreyer ..... 610,737
Canal lock, E. A. Manny ..... 610,548
Candelabrum, H. F. Nehr ..... 610,821
Cane sling, J. Mallon ..... 610,816
Car brake mechanism, railway, J. H. Graham ..... 610,676
Car coupling, R. C. Beckett ..... 610,519
Car coupling, A. F. Kuhlmann ..... 610,814
Car coupling, A. M. Larue ..... 610,714
Car coupling, W. J. Trevessick ..... 610,666
Car fender, M. Fernandez (reissue) ..... 11,692
Car fender, W. T. Watson ..... 610,779
Car seat, W. M. Norcross ..... 610,719
Car steering handle, motor, M. H. Smith ..... 610,871
Cars, guard rail for open tramway, J. G. McLaughlin ..... 610,688
Card cutting machine, H. P. Feister ..... 610,526
Carding machine feeding mechanism, T. R. Marsden ..... 610,655
Carpet and weather strip, T. A. Long ..... 610,864
Carpet fabric, two-ply ingrain, H. Hardwick ..... 610,742
Carpet sweeper, B. Haskell ..... 610,603
Carriage cover, O. B. Fobes ..... 610,647
Carrier or holder, J. Quigley ..... 610,870
Carriage spring, S. R. Bailey ..... 610,788
Cartridge shell, C. E. Overbaugh ..... 610,660
Casket, metallic, Hiser & Lupfer ..... 610,537
Caster, S. Gluck ..... 610,860
Celluloid, etc., die for making frames from sheets of, H. E. Miller ..... 610,630
Chain, detachable link, G. W. Fox ..... 610,583
Chain, drive, F. W. Wood ..... 610,751
Cigar box attachment, J. R. Grinsfelder ..... 610,807
Cigar rolling machine, J. Bunn ..... 610,754
Cigarette machine, D. J. Campbell ..... 610,[illegible]
Cleaner. See Boiler cleaner.
Clock, electric, Hope-Jones & Bowell ..... 610,[illegible]
Clock, repeating, A. Bannatyne ..... 610,[illegible]
Clothes, etc., on lines, device for hanging, G. W. Price ..... 610,[illegible]
Clutch for elevators, etc., self-locking, C. B. Cox ..... 610,[illegible]
Coffee pot attachment, A. I. Sandbo ..... 610,[illegible]
Colander, E. A. Beach ..... 610,[illegible]
Collar and cuff turner and edge polisher, R. N. Martz ..... 610,657
Collar and hame and fastening therefor, C. E. Berry ..... 610,792
Commutator brush holder, W. K. Bassford Jr. ..... 610,620
Concentrator, J. Mait ..... 610,764
Coop, folding chicken, Robinson & Stelzer ..... 610,610
Cotton distributer and cleaner, seed, F. Walla ..... 610,667
Corn husker, I. Korn ..... 610,713
Corkscrew, pocket, E. Hammesfahr ..... 610,538
Coupling. See Car coupling. Thill coupling. Trip coupling.
Crushing machine, roller, W. J. Dyer ..... 610,802
Cultivator, G. Lewis ..... 610,546
Curtain fixture, A. Assorati ..... 610,732
Cuspidor and attachment, A. M. McQuarrie ..... 610,556
Cutter. See Bone cutter.
Cycle race registering apparatus, A. L. Baird ..... 610,639
Cycle holder and lock, combined, F. H. Richards ..... 610,722
Dehorning clipper, J. & C. E. Arms ..... 610,669
Dental pliers, E. H. Angle ..... 610,940
Door fastener, L. J. Gamble ..... 610,624
Door hanger, W. S. Boyer ..... 610,598
Draught apparatus, C. E. Berry ..... 610,793
Dredge for mining purposes, hydraulic, G. F. Kibling ..... 610,763
Drier, V. D. Anderson ..... 610,516
Drilling machine, hand, B. F. Smith ..... 610,773
Dye and making same, black, G. Kalischer ..... 610,541
Easel, artist's, A. K. Cross ..... 610,644
Educational appliance, A. W. Baldwin ..... 610,577
Electric motors, apparatus for starting and controlling, T. W. Kloman ..... 610,712
Electrical machine brush, J. W. Dickey ..... 610,705
Elevator safety attachment, G. E. & C. L. Cooke ..... 610,642
Embroidery hoop, W. C. Maynard ..... 610,658
End gate for wagons, dumping, W. S. Witter ..... 610,572
Engine. See Gas engine. Rotary engine.
Exercising device, W. M. Marshall ..... 610,716
Fabric. See Carpet fabric.
Fan, ventilating, M. Rolle ..... 610,851, 610,852
Fanning device, H. De Tamble ..... 610,601
Fencing, apparatus for applying stay wires to wire, S. G. & W. J. Mooney ..... 610,819
Fender. See Car fender. Stirrup fender. Stove fender.
Fifth wheel, I. Cornwell ..... 610,643
Filter, F. Fischer ..... 610,527
Filter frame, Aymer & Nevill ..... 610,596
Fire escape, C. S. Ramos ..... 610,562
Fire escape ladder, R. Schapler ..... 610,692
Fire extinguisher, A. M. Ring ..... 610,830
Fireproof curtain, rolling, W. R. Kinnear ..... 610,543
Fireproof structure, W. R. Robinson ..... 610,832, 610,833
Fishing reel, A. W. Hazelrigg ..... 610,604
Fishing rod, J. W. Perkins ..... 610,880
Flagstaff holder, J. Finnegan ..... 610,738
Flat iron heater, J. D. Sullivan ..... 610,836
Flooring and ceiling set combined, S. A. Thompson ..... 610,568
Flushing apparatus, P. Liebig ..... 610,683
Food and preserving same, fermented milk, M. L. Arakelian (reissue) ..... 11,691
Fruit jar, L. K. Royer ..... 610,834
Funnel, automatic, C. Bonafede ..... 610,521
Furnace. See Smelting furnace.
Furnace, G. Beesley ..... 610,791
Furnace, R. L. Walker ..... 610,778
Game, H. G. Hellier ..... 610,534
Game apparatus, F. W. Brennan ..... 610,734
Garment, J. A. Scriven ..... 610,564

(Continued on page 206)

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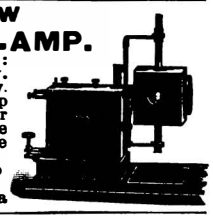
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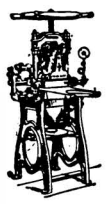
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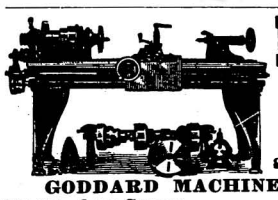
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| Gas motor, Pratis & Marengo | 610,869 |
| Gas, etc., process of and apparatus for making hydrogen, Pratis & Marengo | 610,867 |
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| Gate, J. Ozenberger | 610,661 |
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| Glass, machine for rolling wire, C. C. Hartung | 610,586 |
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| Grading machine, road, J. V. Maxey | 610,550 |
| Grate, W. Edgar | 610,674 |
| Grate, R. A. May | 610,551 |
| Grate, D. J. McKenzie | 610,687 |
| Grinding mill, J. F. Winchell | 610,729 |
| Guillotine for fowls, hand, J. H. Stevenson | 610,591 |
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| Hanger. See Bicycle hanger. Door hanger. | |
| Harrow, P. A. Schumacher | 610,611 |
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| Heater. See Flat iron heater. Tank heater. Water heater. | |
| Heating apparatus, hot air, H. J. Piron | 610,689 |
| Heating apparatus, hot water, W. J. Miller | 610,685 |
| Hinge, gate, H. F. Nehr | 610,820 |
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| Horse power, L. R. White | 610,595 |
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| Hub, vehicle wheel spring, W. W. Lacey | 610,607 |
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| Ice creeper, J. W. Brayman | 610,842 |
| Indicator. See Speed and distance indicator. Station indicator. | |
| Inhaler, J. M. Munyon | 610,717 |
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| Journal box, V. Wigelius | 610,571 |
| Kiln. See Malt kiln. | |
| Knob fastening, door, G. R. Moore | 610,631 |
| Leather dressing machinery, W. S. Shaw | 610,613 |
| Lifting jack, E. Huber | 610,651 |
| Lifting platform, vertically, J. Doldt | 610,602 |
| Lock. See Sash lock. | |
| Lock, J. C. Coltrim | 610,702 |
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| Lock mechanism, coin operated, Bodnar & Kreppel | 610,578 |
| Locomotive, C. A. Couch | 610,856 |
| Loom for weaving looped pile fabrics, G. H. Sargent et al | 610,563 |
| Loom takeup mechanism, J. H. Northrop | 610,636 |
| Looms, knife sled motion for plush or velvet, J. Killars | 610,711 |
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| Mercerizing apparatus, A. Wyser | 610,619 |
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| Milk tester, centrifugal, Hoyt & Feldmeier | 610,650 |
| Mill. See Grinding mill. Windmill. | |
| Milling machine tail stock, C. L. Grohmann | 610,677 |
| Mirror, mouth and throat, H. Bausch | 610,518 |
| Mould. See Tile forming mould. | |
| Money packet or holder, P. Schlemmer | 610,727 |
| Mop wringer, W. D. Martin | 610,549 |
| Motor. See Gas motor. | |
| Mower, lawn, L. H. Slaght | 610,694 |
| Mowing machine, J. W. Cypher | 610,671 |
| Nut and bolt lock, J. G. Venable | 610,777 |
| Nut lock, Holmes & Campbell | 610,679 |
| Nut lock, C. E. Laraway | 610,815 |
| Nut lock, W. H. Nesbitt | 610,879 |
| Nut lock, Pendley & Fincher | 610,878 |
| Nut lock, W. C. White | 610,838 |
| Oculists' trial frame, O. T. May | 610,817 |
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| Oils or fats, apparatus for treating, C. G. Heppburn | 610,812 |
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| Pad. See Buffing pad. | |
| Paper box, R. P. Brown | 610,522 |
| Pen, fountain, G. H. Means | 610,818 |
| Perforating machine, M. H. Merriam | 610,746 |
| Phonograph, T. A. Edison | 610,706 |
| Photographic background carrier, M. C. Harriman | 610,808 |
| Photographic pellicle and producing same, H. Goodwin | 610,861 |
| Pipe. See Smoking pipe. Tobacco pipe. | |
| Pipe trimmer and cutter, J. L. Raney | 610,829 |
| Pipe wrench, O. F. Roberts | 610,831 |
| Planter, J. D. Schofield | 610,771 |
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| Planter, check row, Allen & West | 610,786 |
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| Post driver, R. Heaton | 610,811 |
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| Press. See Baling press. Barrel press. | |
| Pulley, C. Rocholl | 610,724 |
| Pulley and device for securing same to shafts, Z. Auger | 610,576 |
| Pulpware, manufacture of, H. Thame | 610,567 |
| Pump, hydraulic, C. F. Carty | 610,798 |
| Punching and shearing machine, Guild & Bertsch | 610,584 |
| Puzzle map game, A. G. Jacobs | 610,628 |
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| Rake. See Horse rake. | |
| Rasp punching machine, J. Turner | 610,618 |
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| Sash holder, R. H. Fenn | 610,805 |
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| Signal, F. Dutcher | 610,672 |
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| Spindles, apparatus for applying cop tubes to, E. Herzog | 610,605 |
| Spinning machine twist indicator, Meats & Dean | 610,552 |
| Spout, dumping, M. Ryder | 610,690 |
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(Continued on page 207)


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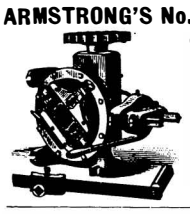
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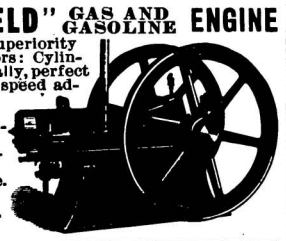
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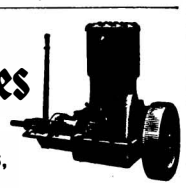
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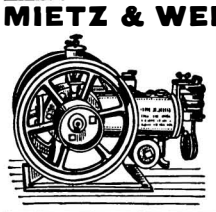
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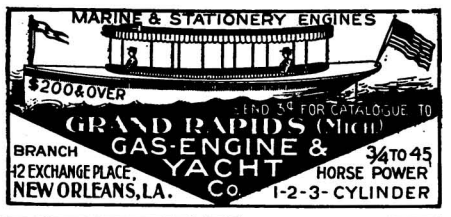


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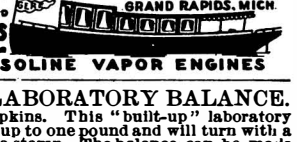
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